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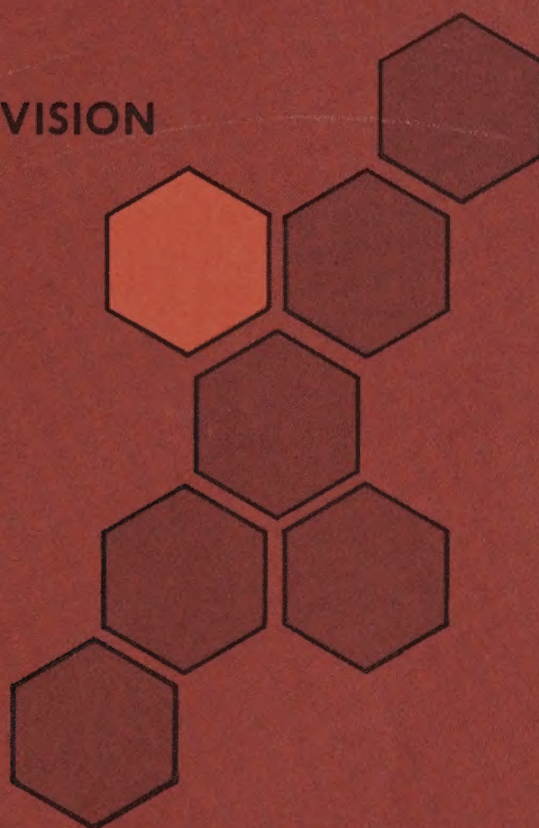


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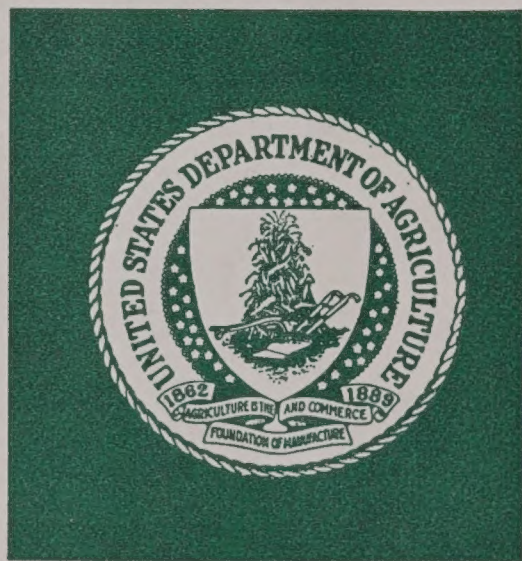
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EFFECTS OF LIVESTOCK ENTERPRISES, FARM SIZE,  
CROP YIELDS, AND PRICES ON OPTIMAL ORGANIZATION  
AND NET RETURNS ON FARMS,

WESTERN CENTRAL KANSAS - AREA III  $\Delta/D \neq 0$

by

Charles W. Nauheim and Milton H. Erickson .

~~April, 1974~~

Commodity Economics Division  
Economic Research Service, U.S.D.A.

In Cooperation with

Department of Economics  
Agricultural Experiment Station  
Kansas State University of Agriculture and Applied Science  
Manhattan, Kansas

U.S. DEPT. OF AGRICULTURE  
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## PREFACE

This publication is an outgrowth of a cooperative project of the Kansas Agricultural Experiment Station, Department of Economics, and the Commodity Economics Division (formerly the **Farm Production Economics Division**), Economic Research Service, U.S. Department of Agriculture. It is based, in part, on the cooperative Regional Research Project GP-5 "Economic Problems in the Production and Marketing of Great Plains Wheat", of the U.S.D.A. and Departments of Economics in these Agricultural Experiment Stations: Colorado, Kansas, Nebraska, North Dakota, Oklahoma, South Dakota and Texas.

General objectives of GP-5 were: (1) to determine, for representative farms in selected areas, supply response and farm organization that produce maximum returns, at various price levels and price relationships, with emphasis on wheat, feed grain, and livestock; (2) to estimate aggregate subregional and regional supply functions for major commodities; and (3) to provide guides for achieving profitable farm organization under changing market demands (prices).<sup>1/</sup>

Study results for the western part of Central Kansas (Area III) reported in this publication, were developed under Kansas Agricultural Experiment Station Project No. 5919 and Economics Research Service Project No. FE 9-23.

The authors acknowledge the assistance of William F. Lagrone, Ronald D. Krenz, Orlan H. Buller, and members of the GP-5 Production Sub-committee. We also appreciate the information and guidance provided by members of the Branch Agricultural Experiment Stations in Kansas and of the Departments of Agronomy, Agricultural Economics, Agricultural Engineering, and Animal Science and Industry at Kansas State University.

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<sup>1/</sup>Glenn A. Helmers and W.F. Lagrone, Wheat and Feed Grains in the Great Plains and Northwest: Supply Response and Resource Use, (Nebr. Agr. Expt. Sta., Great Plains Agricultural Council Pub. No. 37, Research Bull. 236, April, 1970) and W.F. Lagrone, Roy E. Hatch, and Glenn A. Helmers, Wheat and Feed Grains in the Great Plains and Northwest: Study Area Descriptions and State Statistical Summaries, (Nebr. Agr. Expt. Sta., Great Plains Agricultural Council Pub. No. 38, Research Bull. 237, April 1970) report the results of Regional Research Project GP-5.



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## SUMMARY

Our objectives were to: (1) estimate supply response for wheat and feed grains, resource use, and net returns for specified farm situations with various price relationships for wheat and feed grains; (2) aggregate the response for a representative farm to obtain an area supply response function; (3) compare and analyze the resource use, and net returns for the specified farm situations (including those with various combinations of livestock, three farm sizes, and three levels of crop yields.)

Linear programming was used to determine the optimal organization of crop and livestock enterprises that would maximize net returns for each farm situation with no government acreage restrictions or price supports, but with specified constraints on livestock enterprises. Feed grain price levels (same as corn) were set at \$.80, \$.94, and \$1.21 per bushel, with no support programs. Wheat prices, parametrically programmed, ranged from \$.80 to \$3.00 per bushel,--which recognized that the price of wheat can and often does move independently of feed grain and livestock prices. Prices of other crops and of livestock were held constant, except that for one farm situation beef cattle prices also were varied from \$15.20 to \$39.34 per cwt., with wheat and feed grain prices all parametrically programmed.

The size of each specified farm situation remained constant throughout the analysis. Thus, capital investment in land remained constant. Operating capital was specified as unlimited at seven percent interest. Labor available for hire was limited to .6 man year for each farm situation, except as otherwise stated. Only beef cattle and hogs were considered as alternative livestock enterprises. Commercial cattle feeding, dairying, feeder pigs, sheep, and poultry enterprises were not considered. Farm operators were not allowed to purchase feed grains or hay and silage for livestock because only a small percentage of farmers in the area normally make such purchases. The only exception was a grain-livestock farm programmed to allow selling of wheat produced and the buying of feed grain for feeding when profitable. It became more profitable to sell wheat and buy feed grain as the price spread between wheat and feed grain increased, a situation that normally could not be maintained under a free market. Wheat could be fed as a part of grain rations when profitable.

The supply response indicated that wheat replaced most of the feed grains when the wheat price was 10 to 27 percent above the feed grain price. Without government programs or with programs that permit substitution of wheat and feed grains, changing price relationships between wheat and feed grains could cause substantial shifts between the two crops, in Area III. With wheat at \$1.25 and feed grain prices at \$.94, returns on the grain-beef farm would not cover both variable and fixed costs. That would indicate that, in recent years, government program payments may have provided area operators enough additional income to avoid financial distress.

Livestock enterprises, when added to a grain farm, in Area III, increased capital and labor requirements, as well as net returns. Returns to an operator's labor and management ranged from -\$3,849 on the grain-beef cow farm to \$4,746 on the grain-hog farm, with \$1.25 and \$.94 feed grain. The farm with a beef-cow enterprise produced the lowest return. However, the grain farm would have had the lowest returns if native pasture had not been rented out at \$4.50 per acre. The most



profitable beef enterprise was wintering calves in a drylot when wheat was at \$1.06 and \$1.25 per bushel, but with \$1.81 wheat, the most profitable beef enterprise was "wintered calves" sent on to a custom feedlot to finish. The higher wheat price caused an increase in wheat production and a decrease in the number of calves wintered in a drylot. The grain-livestock farm (with both beef and hog enterprises) required more labor and capital and produced slightly less returns than did the grain-hog farm. The operator furnished most of the labor except for one or two peak periods. May-hired labor was a limiting resource. Strong demand for meat in the face of low grain prices (which encourage livestock production) should make grain feeding enterprises attractive and profitable. With the prices used in this study, the hog enterprise was more profitable than the fed steer enterprise.

Increasing the size of the grain-beef farm increased gross income and lowered unit costs by spreading fixed costs over more units. However, increasing the size of the average grain-beef farm in Area III by 50 percent still did not produce enough income, with \$1.25 wheat and \$.94 feed grain, to cover all costs. With \$1.81 wheat, however, the 50 percent increase in size increased returns to operator's labor and management from \$2,469 to \$4,503. Increases in farm size required additional labor and operating capital.

By increasing crop yields, through better management techniques, the operator increased his returns with little additional capital and labor. Increased crop yields also permitted additional livestock production, which required more capital and labor. Returns on the average grain-beef farm with average yields did not pay all costs with \$1.25 wheat. By increasing crop yields 20 percent, returns were increased by \$2,217, thus producing a small return to the operator's labor and management. This increase in returns was substantially greater than that produced by increasing farm size by 50 percent. With \$1.81 wheat, increasing yields 20 percent produced about \$1,000 more net returns to operator's labor and management than did increasing farm size 50 percent.

Farms of average size with average yields in Area III face low returns if recent market prices of grains (prior to August 1972) continue and government price supports are not available. Many farm operators could improve their net returns by adding or expanding profitable livestock enterprises, increasing farm size, or increasing crop yields.

With wheat, feed grain, and beef prices all increasing parametrically, the average grain-beef farm did not pay all costs until prices were slightly above \$1.38/bu. wheat, \$1.19/bu. for feed grain (corn equivalent) and \$26.54 per cwt. for beef. A moderate return for the operator's labor and management (\$5,284) was produced when prices reached \$1.81 a bushel for wheat, \$1.40 a bushel for feed grain, and \$34.19 per cwt. for beef.



EFFECTS OF LIVESTOCK ENTERPRISES, FARM SIZE, CROP YIELDS,  
AND PRICES ON OPTIMAL ORGANIZATION AND NET RETURNS ON FARMS,  
WESTERN CENTRAL KANSAS - AREA III

Charles W. Nauheim and Milton H. Ericksen 1/

INTRODUCTION AND OBJECTIVES

Measures enacted by Congress to maintain commodity prices above their equilibrium market clearing prices and to avoid unmanageable farm surpluses have not always been successful largely because of incomplete information about the productive capacity of the nation's agricultural base and poor predictions of farmer response to policy guidelines.

Over time the relative demand for wheat, livestock, and feed grains have been changing. In recent years the demand for grain-fed livestock has increased substantially, while the demand for wheat has declined. Differences in resources and improved technology available to various farms and producing areas affect their capacity to adjust and become competitive. Government programs also have greatly influenced production patterns for wheat, feed grains, and livestock. Because the adjustment capacity of various farms and areas may differ substantially, changes in demand (as reflected by prices) quite likely, will have diverse effects on production patterns and economic returns for different farms and different areas.

This study was part of a large scale research effort designed to provide new information about supply response, resource use, and net returns under a wide array of wheat and feed grain price combinations for the Great Plains and Northwest region. 2/ Such information is needed to evaluate government programs and policy, as well as, local and regional impacts of changing prices, and to provide insights about adjustment on individual farms. The supply response (production adjustments) for representative farm situations caused by various price relationships for wheat and feed grains was estimated through linear programming. The analyses were based on procedures to determine, for representative farms, optimal organization that would maximize net returns, with no government acreage restrictions or price supports and with specified constraints on livestock enterprises.

The objectives of this study were to: (1) estimate the supply response for wheat and feed grains, resource use, and net returns for several specified farm situations at various price combinations for wheat and feed grains, (with constant prices for other crops and livestock);

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2/See Preface.



(2) aggregate the supply response for a representative or average farm situation to obtain an area supply response function; and (3) analyze resource use and net returns for the specified farm situations (including farms with various combinations of livestock enterprises, three farm sizes, and three levels of crop yields).

Kansas was divided into five adjustment areas on the basis of precipitation, cropping practices, and soils. Crops grown, cropping practices, yields, and livestock potentials were similar within each individual area for which representative farms were defined.

In this report we analyze the aggregate supply response of wheat and feed grains for Kansas Adjustment Area III and present the results for other specified farm situations to compare the relative effects of various livestock enterprises, farm size, crop yields, and price increases on resource use and returns.

### Study Area

Area III, the study area, includes 22 counties in the western part of central Kansas (figure 1). The average-size farm in 1964 was 777 acres, which included 456 acres of cropland.

Topography ranges from hilly, adjacent to streams and rivers and in the "Red Hills" pasture area bordering Oklahoma, to nearly level to rolling on cropland. Soils range from brown sandy loams and loams to dark brown silty clay and reddish-brown clays. The lighter-textured soils south of the Arkansas River have a high water table and further development of irrigation is expected. (Less than 2.5 percent of the cropland was irrigated in 1969.) About three fourths of Area III, all north of the Arkansas River, is covered by a dark grayish brown silt loam (loess) to depths of 4 to 25 feet. The less-fertile soils respond to good management and fertilizer, particularly in years with average or above precipitation. With recommended cropping practices and fertilizer use, the various soils are nearly equally productive. <sup>3/</sup>

Average precipitation in Area III ranges, east to west, from 24" to 20". In most years, lack of moisture limits crop production in this transitional area (between continuous cropping to the east and crop - summer fallow to the west). Since 1965, about 60 percent of the wheat has been grown on fallowed land. Prior to government programs with "diverted land," most of which is summer fallowed in this area, only 20 to 25 percent of the wheat was seeded on fallow. Since 1965, wheat the predominant crop, has been grown on almost half of the cropland; grain sorghum, the major alternative, on about 7 percent; and alfalfa on small acreage for livestock feed; and corn, barley and oats each on less than a half percent.

Livestock are found on 75 percent of the farms. <sup>4/</sup> Many farmers either keep a small cowherd or purchase cattle in the fall to use farm

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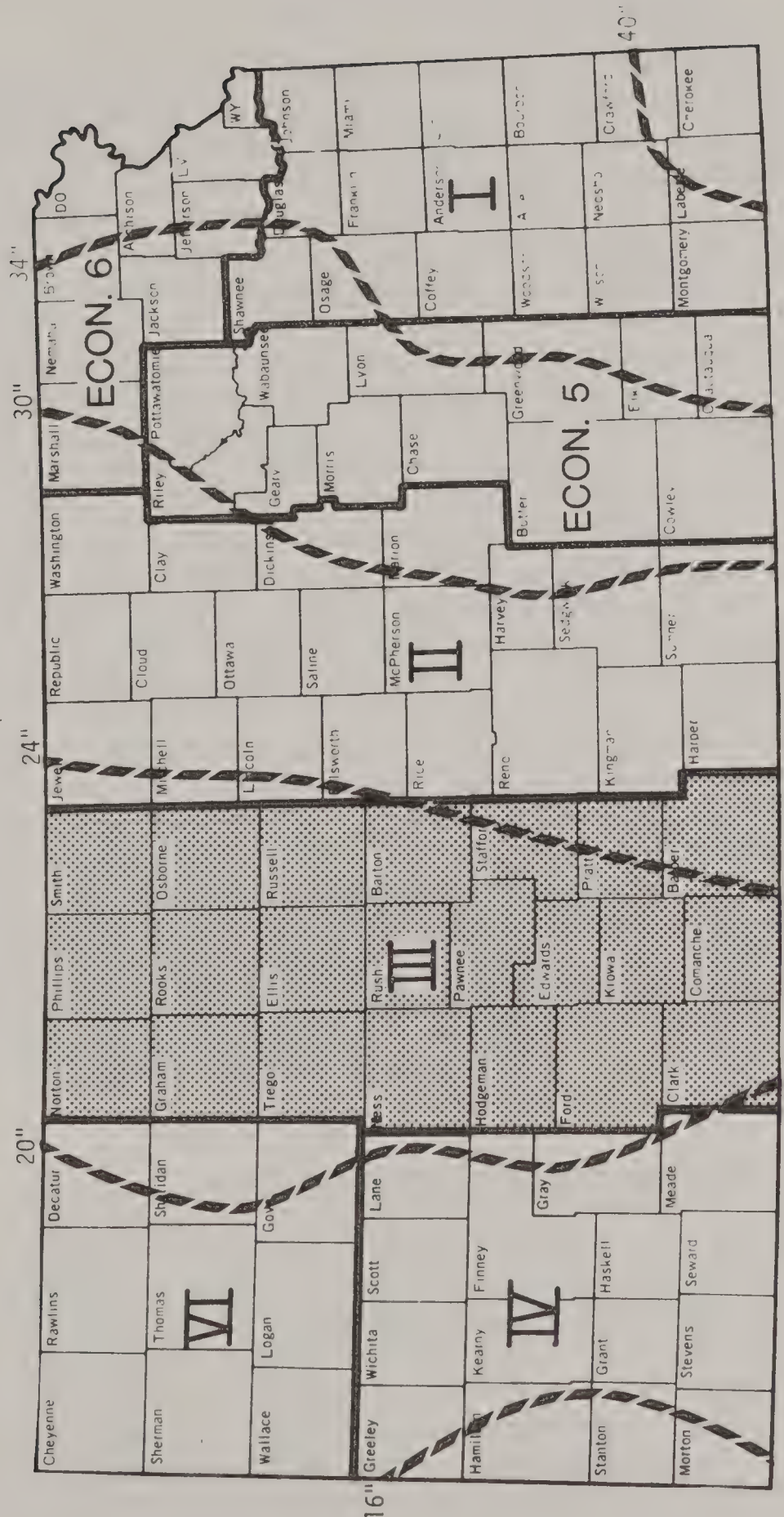
<sup>3/</sup>Bidwell, O.W. Major Soils in Kansas, Kans., Agr. Expt. Sta., Cir. 336, July 1956, p. 17.

<sup>4/</sup>1969 Census of Agriculture reports cattle, hogs, or sheep on 75% of all farms in the area. Cattle were reported on 72% of the farms, cows and heifers calved on 58%; 25 or more hogs were sold on 14%.



Figure 1. ADJUSTMENT AREAS I, II, III, IV, VI, E.5, and E.6, KANSAS

Annual Precipitation 1931-60 (broken line)



AVERAGE SIZE OF FARM (1964 Census) AND CROPS IN ORDER OF IMPORTANCE, BY AREA

- I - Size farm, 288 ac. - "General farming" - Wheat, corn, soybeans, sorghums, alfalfa, wild hay.
- II - Size farm, 428 ac. - "Continuous cropping" area. Wheat is major crop. Grain sorghum major alternative. Alfalfa, barley, corn, oats, soybeans.
- III - Size farm, 777 ac. - "Transition" area with 20 to 65% wheat on fallow. Sorghum good alternative. Alfalfa, barley. Lighter soils south of Arkansas River, use similar practices.
- IV - Size farm, 1,383 ac. - "Dryland": Wheat on fallow, sorghum (excellent alternative), barley. "Irrigated" sorghum, wheat, corn, alfalfa. Sandy soils south of Rivers used for continuous sorghum.
- VI - Size farm, 1,114 ac. - "Dryland": Wheat on fallow, sorghum (good alternative), barley, alfalfa. "Irrigated" sorghum, wheat, corn, alfalfa.
- E.5 - Size farm, 558 ac. - Flint Hills Pasture, wheat, sorghum, alfalfa, corn, soybeans, wild hay.
- E.6 - Size farm, 276 ac. - (Corn area), Corn, wheat, sorghum, alfalfa, soybeans.



produced roughage. Farm fed steers and hogs are produced on a relatively small percentage of the farms. Less than 26 percent of the area farmers purchase feed grain and less than 19 percent buy hay or silage according to the 1969 census.

### Assumptions and Procedures

We used assumptions and procedures developed by regional research committees to study supply response of wheat and feed grains in the Great Plains and Pacific Northwest. <sup>5/</sup> They deal with prices, representative farms, enterprise budgets, and capital and labor availability and government commodity programs.

Linear programming was used to determine optimal organization of crop and livestock enterprises for each farm situation specified, using a wide array of prices for wheat and feed grains. Government programs, with price supports and acreage restrictions, were excluded. The programming objective was to maximize net returns to fixed costs and operator's labor and management. Land and labor were considered limited resources. The size of each farm specified remained constant throughout the analysis. Thus, investment capital in land was constant. Operating capital was specified as unlimited at 7 percent interest.

Feed for livestock, other than protein and minerals, had to be produced on the farm. Wheat and feed grains could be either sold or fed; however, the amount of grain that could be fed was limited to 60 percent of total production, as a precaution against feed shortages resulting from variability of grain production in the area. Hay could not be sold off the farm. Our justification for these restrictions was; (1) that they would permit reliable supply-response estimates for wheat and feed grains for individual farm situations and for areas (without such constraints operators could feed more than is produced in an area, thus requiring imports from other areas at prices higher than those specified) and (2) that feed grains and roughage (hay or silage) were not purchased by 74 and 81 percent, respectively, of all farmers in Area III in 1969 (Agricultural Census). It is recognized that some operators, especially those with feed lots, may purchase feed grains, hay and silage to feed to livestock.

### Government Commodity Programs

Government programs, with price supports and acreage restrictions, were excluded from the programming model, since its main purpose was to obtain a supply-reponse surface over a wide array of prices for wheat and feed grains. This permitted us to examine the competitive position of various crops in Area III, and with other areas, to derive supply-response curves for wheat and feed grains. Also, it allowed the most profitable adjustments in farm organization in response to various combinations of wheat and feed grain prices.

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<sup>5/</sup>"Wheat and Feed Grains in the Great Plains and Northwest: Supply Response and Resource Use", Research Bull. 236, Agr. Expt. Sta., Univ. of Nebr. (Great Plains Ag. Council Pub. No. 37).



The results thus obtained are quite useful in predicting the response under government programs such as provided for in the Agricultural Acts of 1970 and 1973 which allow considerable choice to the producer. Producers are permitted to substitute freely the wheat and feed grain acreages allowing greater flexibility. Shifts in patterns of production may now take place on the basis of their profitability.

### Prices Used

Prices paid by farmers for production items, interest, and wages were set on the basis of expectation for 1970. Prices received by farmers for farm products were determined largely by the regional research project (table 1). <sup>6/</sup> The three "feed grain prices" used (\$.80, \$.94, and \$1.21 per bushel) were selected under the assumption of no government commodity programs. No. 2 cash corn became the basic "feed grain" and Kansas City the base terminal market. Area prices for feed grains were based on the Kansas City corn price minus transportation costs. Feed grains other than corn were indexed to a "feed grain unit" with corn equaling 1.00.

The price of wheat can and often does move independently of feed grain and livestock prices over the short run. Prices of most commodities may change substantially within a short time. Except for wheat and feed grain, prices used reflect long run relative price differences between commodities. <sup>7/</sup>

Wheat prices used in the supply-response analyses, for each feed-grain price, were parametrically programmed to determine optimal farm organization over a wide range of prices, from \$.80 to \$3.00 per bushel. The range in wheat price was used to obtain a supply-response surface over a wide array of prices for wheat and feed grains; thus, government acreage restrictions and price supports were not included.

In recent years, government programs have guaranteed full parity price for domestic allotment wheat on farms participating in the wheat program. Average wheat prices received by farmers during the period 1967-1969 are shown below:

	<u>Averages 1967-69</u>		
	<u>U.S.</u>	<u>Kansas</u>	<u>Area III</u>
Market price wheat (seasonal average). . .	\$1.29	\$1.26	\$1.25
<u>Participants in wheat program</u>			
Price received for all wheat produced. . .	1.85	1.82	1.81
(market price+av.value mktg. certif.)			
Price for domestic allot. wheat (parity). . .	2.67	2.64	2.63
(market price+full value mktg. certif.)			

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<sup>6/</sup>"Wheat and Feed Grains in the Great Plains and Northwest: Supply Response and Resource Use," Research Bull. 236, Ar. Expt. Sta., Univ. of Nebr. (Great Plains Agr. Council Pub. #37.)

<sup>7/</sup>The level of model prices, costs, and values need not be completely accurate, but they should reflect the relative differences or relationships that normally would be expected.



Table 1.--Prices used for analyses, with comparisons, Area III, Kansas

Commodity	Unit	Av. market price received <sup>1/</sup>			Price used in this study
		1960-69	1965-69	1967-69	
		\$	\$	\$	\$
Wheat . . . . .	Bu	N.A.	1.35	1.25	1.25 (.80 to 3.00)
Corn (feed grain unit) <sup>2/</sup>	"	1.11	1.14	1.08	.94 (.80 and 1.21)
Sorghum, grain . . . . .	"	.95	.97	.94	.85 (.73 and 1.10)
Pasture rent . . . . .	Acre	--	--	5.00	4.50
Cows . . . . .	Cwt.	15.16	16.52	17.50	17.19
Calves . . . . .	"	24.10	25.78	27.50	28.60
Steers & heifers . . . . .	"	23.11	24.42	25.46	(See below)
Hogs--all	"	18.16	20.66	18.86	18.75

Livestock	Prices paid			Prices received		
	Mo.	Wt.	Price	Mo.	Wt.	Price
		Lbs.	\$/cwt.		Lbs.	\$/cwt.
Calves, wintered . . . . .	Oct.	430	28.13	Apr. . . . .	637-725	26.00
Calves, wintered-grazed . . . . .	Oct.	430	28.13	Sept. . . . .	731	25.80
Steers, fed (purchased) . . . . .	Oct.	680	25.52	Apr. . . . .	1,075	25.27
Steers, fed (on farm) . . . . .	Sept.	731	-	Apr. . . . .	1,126	25.27
Steers, fed (custom lot) . . . . .	Apr.	640	26.00	Sept. . . . .	1,040	26.00
Cows, culls . . . . .	-	-	-	Nov. . . . .	1,000	17.19
Calves, produced . . . . .	-	-	-	Sept. . . . .	430	28.60
Sows, culls . . . . .	-	-	-	Jan.-July . . . . .	370	17.10
Gilts, nonbreeders & culls . . . . .	-	-	-	Jan.-July . . . . .	290	18.15
Barrows & gilts . . . . .	-	-	-	Mar.-Sept. . . . .	220	19.00
Boar (20 sow unit) . . . . .	-	Head	150.00	-	400	15.00
Hogs (weighted av. all) . . . . .	-	-	-	-	-	18.75

Item	Unit	Price paid	Used per acre	Item	Unit	Price paid
		\$	Lbs.			\$
<u>Seed for:</u>				<u>Fertilizer:</u>		
Wheat . . . . .	Lb.	3/	50	Nitrogen . . . . .	Lb.	4/ .11
Barley . . . . .	"	3/	65	P <sub>2</sub> O <sub>5</sub> . . . . .	Lb.	.09
Sorghum, hyb. . . . .	"	.22	3.5-4			
Sudan . . . . .	"	.13	14	<u>Pesticides:</u>		
Rye . . . . .	Bu.	1.80	50	2-4-D material . . . . .	Lb.	1.25
Alfalfa . . . . .	Cwt.	54.00	12.5	2-4-D 1/3# apply airpl.	Ac.	1.90
Protein suppl. . . . .	Cwt.	5.50	-	<u>Interest:</u>		
Corn for feed . . . . .	Bu.	1.04	-	Operating capital . . . . .	Pct.	7.0
Sorghum (feed) . . . . .	Bu.	.95	-	Machinery . . . . .	"	7.0
				Improvement . . . . .	"	6.0
Hired labor . . . . .	Hr.	1.31	-	Real estate . . . . .	"	5.0

<sup>1/</sup>Seasonal average price on crops to Kansas farmer (SRS). Pasture rent Area III.  
<sup>2/</sup>One bushel of feed grain is equivalent to one bushel of corn in feed value,  
Appendix table 3. <sup>3/</sup>Cost varies with change in price of crop. New seed is purchased once in four years. Crop sales reduced to offset cost of using homegrown seed, cleaned and treated. <sup>4/</sup>Estimated cost of nitrogen from various fertilizers used in area, includes cost of applying anhydrous ammonia (approx. \$1.50 per acre).



Wheat prices of \$1.06, \$1.25 and \$1.81 per bushel were used in analyzing specified farm situations to compare livestock enterprises, sizes of farms, and various crop yields, with feed grain priced at \$.94 per bushel. The \$1.06 wheat represents the feed value of wheat when corn is \$.94 a bushel. The \$1.25 wheat represents the average market price (support payments excluded) received by Area III farmers in recent years. To examine the relative effects of a very favorable wheat price on the returns of various farm situations, we used \$1.81 wheat (a relatively high price with corn at \$.94 per bushel and the assumption of no government programs). It could occur with a shortage of wheat.

Prices received for other crops and for livestock were based on projections of Kansas prices and were held constant for all analyses except when prices of wheat, feed grains, and cattle were increased simultaneously to \$2.09 a bushel, \$1.54 a bushel, and \$39.34 per hundred-weight, respectively. The base cattle price, \$25.27 per cwt. for good grade slaughter steers fed on the farm, was adjusted for other kinds and grades of cattle and for seasonal differences.

Prices paid by farmers, for items used in production, were estimated using Kansas prices reported by the Statistical Reporting Service, USDA.

### Farm Situations Studied

The farm situations--programmed for each type of analysis (table 2) were so designed that situations in all four types of analyses could be compared. To analyze supply response we used, the grain-beef combination of enterprises as the representative farm situation in Area III, (in that more than 72% of the farms reported beef cattle in the 1969 Agricultural Census). We used the average size farm, 901 acres estimated for Area III (table 3), along with average crop yields. For the live-stock enterprise analysis, we specified all crops and various combinations of the major livestock enterprises as farm situations, using the average size farm and average crop yields for Area III. For the size analysis, we specified three sizes of the grain-beef farm with average yields, using the average size farm in Area III and two other sizes (40 percent smaller and 50 percent larger than the average farm). For the yield analysis, we specified three levels of crop yields on the average-size grain-beef farm, (high yields were 20 percent above and low yields 20 percent below average yields for the area).

### Enterprise Budgets

Enterprise budgets were prepared for major crops grown and livestock raised in Area III. We did not consider corn and oats as crop alternatives since they occupy less than one half of one percent of the cropland acreage and are being replaced by grain sorghum. Irrigated crops also were excluded since less than 2.5 percent of the cropland is irrigated. Nor did we consider commercial cattle feeding, dairying, and the raising of feeder pigs, sheep and poultry. We considered only the predominant livestock enterprises (beef and hog) expected to affect the supply-response of wheat and feed grains and the income on representative farms. (Because operators were not allowed to purchase feed grains and hay or silage to feed livestock, the "aggregation" of livestock production for the area was incomplete.)



Table 2--Farm situations programmed by type of analysis, Area III, Kansas

Type of Analysis (farm situation)	Farm size 1/		Enterprises allowed to compete											
	Total land 2/	Crop- land	Native past.	Crop yield level 3/	All crops	Cow- calf	Calf, wtr.	Calf wtr.	Calf wtr.	Calf wtr.	Calf wtr.	Calf wtr.	Calf wtr.	Calf wtr.
Supply - response	Ac.	Ac.	Ac.											
1. Grain-beef 4/	901	534	340	Av.	X	X	X	-	X	X	X	X	X	X
Livestock enterprises														
1. Grain	901	534	340	Av.	X	-	-	-	-	-	-	-	-	-
2. Grain-beef cow	901	534	340	Av.	X	X	-	-	-	-	-	-	-	-
3. Grain-beef 4/	901	534	340	Av.	X	X	X	-	X	X	X	X	X	X
4. Grain-beef (excl. calf wtr.)	901	534	340	Av.	X	X	-	-	-	-	-	-	-	-
5. Grain-beef+calf. wtr. drylot	901	534	340	Av.	X	X	X	X	X	X	X	X	X	X
6. Grain-beef+cust. fed steers	901	534	340	Av.	X	X	X	X	X	X	X	X	X	X
7. Grain-hogs	901	534	340	Av.	X	-	-	-	-	-	-	-	-	-
8. Grain-hogs (no limit labor)	901	534	340	Av.	X	-	-	-	-	-	-	-	-	-
9. Grain-hogs (\$1.21 feed grain)	901	534	340	Av.	X	-	-	-	-	-	-	-	-	-
10. Grain-livestock	901	534	340	Av.	X	X	X	X	X	X	X	X	X	X
11. Grain-livestock (no limit labor)	901	534	340	Av.	X	X	X	X	X	X	X	X	X	X
12. Grain-livestock (sell wht, buy f.gr.)	901	534	340	Av.	X	X	X	X	X	X	X	X	X	X
Size of farm														
1. Large grain-beef	1352	801	510	Av.	X	X	X	X	X	X	X	X	X	X
2. Average grain-beef 4/	901	534	340	Av.	X	X	X	X	X	X	X	X	X	X
3. Small grain-beef	540	320	204	Av.	X	X	X	X	X	X	X	X	X	X
Yield level														
1. High yield - grain-beef	901	534	340	120%	X	X	X	X	X	X	X	X	X	X
2. Average yield - grain-beef 4/	901	534	340	100%	X	X	X	X	X	X	X	X	X	X
3. Low yield - grain-beef	901	534	340	80%	X	X	X	X	X	X	X	X	X	X

1/See table 3 for farm sizes and farm numbers in Area III. 2/ Includes woodland not pastured, lots, roads and waste.  
3/High is 20% above and low is 20% below area average. 4/ This situation is used in each type of analysis.



Table 3--Land resources and farm situations Area III,  
Western Central Kansas

Item	Unit	Agricultural Census			1970
		1954	1964	1969	estimated
		<u>1/</u>	<u>1/</u>	<u>1/</u>	<u>2/</u>
<u>Land resources, Area III:</u>					
Number of farms . . .	No.	19,798	15,509	15,205	13,373
Land in farms . . .	Thous.ac.	12,091	12,049	12,121	12,049
Cropland <u>3/</u> . . .	" "	7,263	7,070	<u>4/</u> 7,657	7,141
Average size farm . .	Acres	611	777	797	901
<u>Farm situations:</u>			<u>Estimate for 1970 <u>2/</u></u>		
		<u>Small <u>5/</u></u>	<u>Average</u>	<u>Large <u>5/</u></u>	
Land in farm unit . .	Acres	540	901	1,352	
Cropland <u>3/</u> . . .	"	320	534	801	
Pasture, native . . .	"	204	340	510	
Other land <u>6/</u> . . .	"	16	27	41	

1/U.S. Census of Agriculture data.

2/Estimates based on a sample of farms from 1964 Assessor's Statistical Schedules, Kansas State Board of Agriculture (SRS), and 1954, 1964, and 1969 Census data.

3/Excludes wild hay and "other land".

4/Cropland figures, 1969 Census, are high since some operators listed all their pasture as cropland acreage.

5/Small is 40% smaller and large is 50% larger than the average farm unit.

6/Woodland not pastured, lots, roads, and waste.



Enterprise budgets were developed to reflect average yields, average technology, and expected costs. Additional crop enterprise budgets were developed for both high yield and low yield farm situations, reflecting production costs of above average and below average technology, respectively.

An intermediate length of run or time horizon was assumed, so that operators could make all necessary adjustments in both farm organization and capital structure (particularly farm machinery and livestock facilities) in response to changes in product prices. Therefore, all costs, both variable and fixed, on farm machinery and livestock facilities were allocated to each enterprise on the basis of estimated use. (Detailed budgeting procedures and estimated coefficients are summarized in the Appendix.)

### Capital Availability

Investment capital was held constant for each farm situation by specifying farm size. Investment in land, building, and machinery bore interest charges of 5, 6, and 7 percent, respectively. These charges were considered as opportunity costs for the investments rather than as rental or interest payments on mortgaged land or machinery.

Operating capital, for current expenses (including livestock purchases) and specified as available at 7 percent interest annually was charged as a production cost for the period used. Harvesting and marketing costs, usually paid from sales, were not considered operating capital. Because farm size was fixed and livestock production was limited by the amount of feed produced on the farm, sufficient operating capital would be available to farm operators in the area.

### Labor Availability

A supply of available labor equivalent to 1.6 man-years was specified for each farm situation except as stated. The hours of labor available monthly were derived on the basis of a six-day week and eight to ten hours of labor per man per day depending on the season. We allocated operator and hired labor by month, except that we combined September, October, and November into one period (fall) for the operator (table 4). The operator was to contribute one man-year of labor 2556 hours, fixed to the farm with neither a cost for its use nor any opportunities for off-farm employment. The 0.6 man-year of hired labor (family and other seasonal labor) was paid at a rate of \$1.31 per hour only when used.



Table 4 --Labor available to farm situations by month,  
Area III, Kansas

Month	Oper- ator	Hired <u>1/</u>	Total	:	Month	Oper- ator	Hired <u>1/</u>	Total
	<u>Hours</u>	<u>Hours</u>	<u>Hours</u>	:		<u>Hours</u>	<u>Hours</u>	<u>Hours</u>
January . . .	204	84	288	:	Fall . . . . .	655	-	-
February . .	199	82	281	:	September .	(225)	94	319
March . . . .	209	87	296	:	October . .	(220)	91	311
April . . . .	210	87	297	:	November .	(210)	88	298
May . . . . .	211	88	299	:	December . .	201	83	284
June . . . . .	221	239	460	:				
July . . . . .	219	248	467	:				
August . . .	227	245	472	:	Total	2,556	1,516	4,072

1/ Could include members of operator's family.

#### Fixed Costs

Fixed costs for land, buildings and improvements (other than those used exclusively by livestock), pickup truck, automobile, and miscellaneous items were estimated for each of the three farm sizes (table 5). 8/ These costs (\$10,896 for the average, \$7,040 for small, and \$15,066 for the large farms) were subtracted from net returns over variable costs shown by the programming solutions. A positive difference indicated a return to the operator's labor and management. A negative difference indicated that the net returns for the farm situation were not sufficient (by the amount of the difference) to cover fixed costs. (The interest on investment in land and machinery is not a cash cost for operators who have full equity. For them it is an opportunity cost. Depreciation is not necessarily a cash cost in the short run for operators who want to postpone replacing equipment and facilities. For operators who own substantial or full equity or for those who are postponing equipment replacement, a negative difference does not necessarily indicate that they would have no cash for living expenses.)

8/Based on Census of Agriculture data, assessors' records, real estate sales, estimates by land appraisers and farm management specialists, and unpublished surveys.



### Aggregation of Supply Response

The optimal organizations for the 901-acre grain-beef farm, determined by parametric programming of the wheat price, were transformed into estimates of aggregate supply response of wheat, feed grain, and beef for Area III for each of the three feed grain prices. The estimates were derived by applying to the resulting grain-beef farm organization the aggregation weight of 13,373 (the number of farms estimated to be in Area III, table 3).

Table 5.-- Estimated fixed costs by farm size, 1970, Area III, Kansas

Item	Annual fixed costs by farm size 1/		
	Small	Average	Large
	(540 acres)	(901 acres)	(1352 acres)
	\$	\$	\$
Land 2/ . . . . .	4,564	7,638	11,394
Buildings and improvements 3/ . . . . .	1,232	1,391	1,487
Pickup, auto, tools 4/ . . . . .	1,064	1,187	1,335
Miscellaneous 5/ . . . . .	544	680	850
Total 6/ . . . . .	7,404	10,896	15,066
Per acre . . . . .	13.67	12.09	11.16

1/ Includes interest on investments, depreciation, repairs, taxes and insurance. Based on Census of Agriculture data, Assessors' records, real estate sales, estimates by land appraisers and farm management specialists, and unpublished surveys.

2/ Interest at 5.0% and taxes at 1.2% on total land values of \$73,610, \$123,190, and \$183,770.

3/ Excludes farm dwelling and livestock facilities charged to livestock enterprises. Interest at 6%.

4/ Includes costs on pickup, farm share auto, shop tools, fuel storage and general use of tractor and truck. Other farm machinery costs were allocated to enterprise budgets.

5/ Electricity, telephone, tax service, fees, etc.

6/ Includes interest of \$4,133 (small), \$6,658 (average), and \$9,717 (large).



## RESULTS OF THE PROGRAMMING ANALYSES

### Supply Response of Wheat and Feed Grains

Optimal organizations for the grain-beef farm that occur, as wheat prices are parametrically increased, are shown for three feed grain prices in Appendix tables 4, 5, and 6.

Feed grain (largely grain sorghum) used the bulk of cropland acreage in Area III at the low end of the wheat price range. When the wheat price reached \$1.12, \$1.16, and \$1.57 per bushel (with feed grain priced at \$.80, \$.94, and \$1.21 per bushel, respectively), most of the cropland use shifted from grain sorghum to wheat. Further increases in the wheat acreages, though much less dramatic, occurred at successively higher wheat prices as wheat replaced more of the sorghum and summer fallow acreages. Beef cows and fed steers, although included as alternative beef activities, were not so profitable as the calf-wintered enterprise and did not enter the solutions. The number of calves wintered were not reduced by the price of either feed grain or wheat until wheat prices reached \$1.89 and \$1.94 per bushel. At these prices, wheat began to take over some of the land used to produce feed crops.

Figures 2 and 3 indicate Area III's potential production capacity for wheat, feed grains, and beef at different wheat - feed grain price relationships. Though the wheat price at which land use shifted from feed grain to wheat, on the grain-beef farm, was different for each feed-grain price level, each major shift occurred when the wheat price was about 120 to 130 percent of the feed grain (corn) price (or about 130 to 142 percent of the grain sorghum price). Without government programs, or with programs allowing complete substitution between wheat and feed grain, shifts in production were profitable at these price ratios on the farm situations programmed in Area III, except for farms producing hogs.

The potential production capacity of Area III for wheat and feed grain indicated by this analysis (figure 2) is substantially greater than the reported average production during the period 1965-69 (wheat 62,635,800 bushels at \$1.37 per bushel; and "feed grain" 19,161,100 bushels at \$1.19 per bushel (corn price)). Eighty-seven percent of the feed grain was grain sorghum.

Acreages of hay, silage, forages, cropland pasture and fallow during that period were greater than those shown by the programmed organizations. These crops and uses qualified as conserving crops and diverted acreage so wheat and feed grain acreages were determined largely by the farms participating in government programs.

Even though our livestock data are incomplete, figure 3 shows that aggregate net beef production (gain in weight) decreased as the wheat price increased beyond \$1.50 per bushel with all three feed grain prices. The feed grain price had little effect on the production level of beef on the grain-beef farm because the most profitable beef enterprises were based on roughage consumption, largely. As the price of wheat increased, the feed grain and silage acreages were shifted to wheat and some calves were switched from wintering to winter and summer grazing; the calves



## WHEAT PRICE

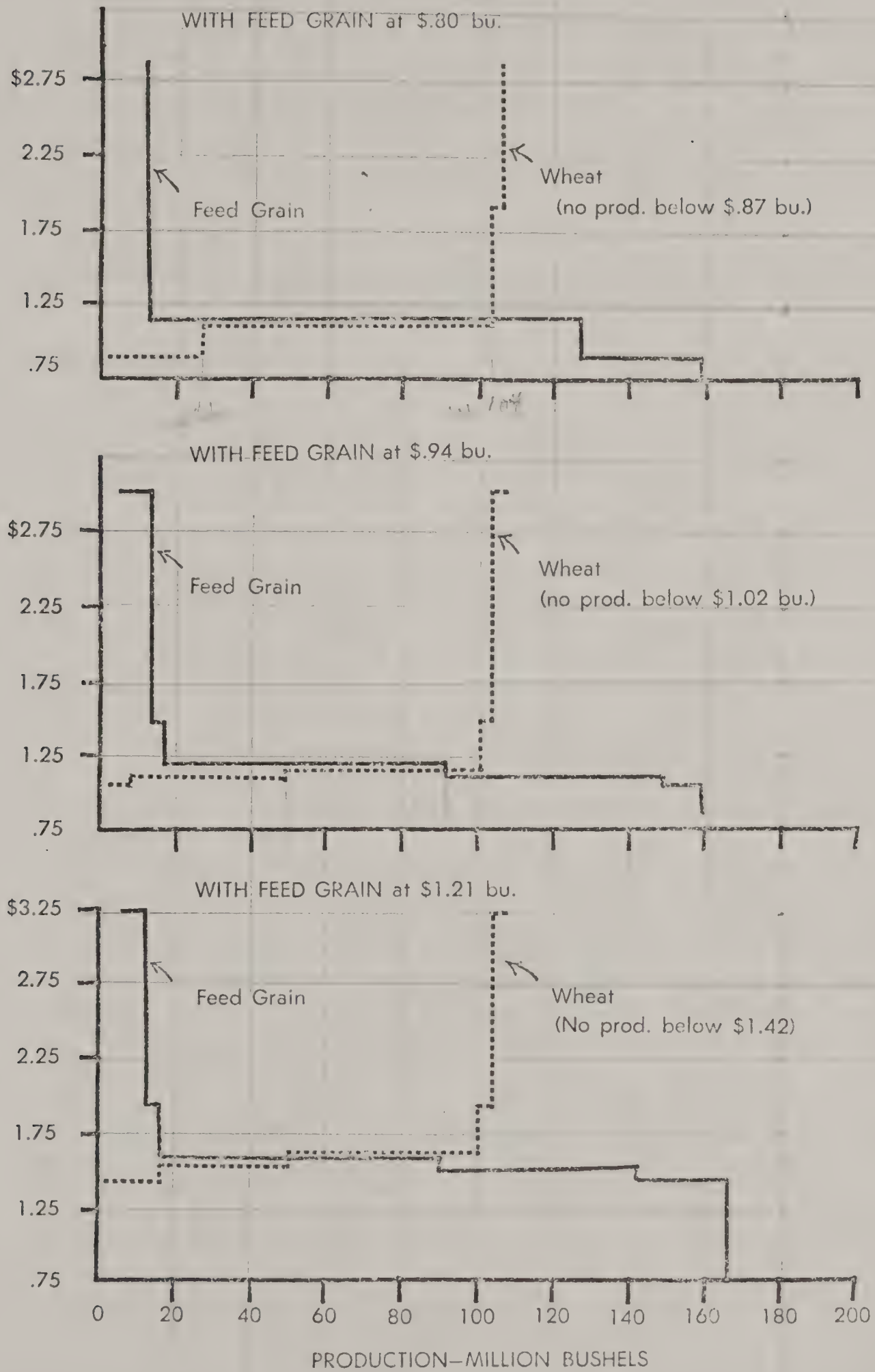


Fig. 2. Potential Production of Wheat and Feed Grain (Corn Equivalent) at various prices, Area III, West-part Central Kansas.



then required no grain, but did require more pasture per head than they did in the wintering enterprise. Thus, that shift resulted in a reduction of calf numbers and, consequently, of beef production.

Estimated aggregate returns to operator's labor, management, and fixed costs at various wheat-feed grain price combinations are shown for Area III in figure 4. At the low end of the wheat price range, no wheat was produced and returns remained constant (for each feed grain price) because feed grain and livestock prices were constant. As wheat price increased, wheat entered the farm organization and returns increased.

### Effects of Livestock Enterprises on Organization, Capital and Labor Requirements and Returns

#### Organization of farms

The average size farm in Area III was used to study farm situations with grain, grain-beef cow, grain-beef, grain-hog, and grain-livestock enterprises, with specified variations of the last three situations. The most profitable organization for each farm situation in the livestock enterprise analysis is discussed briefly for each of three wheat prices (\$1.06, \$1.25, and \$1.81 per bushel) with feed grain priced at \$.94 per bushel (Appendix tables 7, 8, and 9).

Wheat at \$1.06 per bushel. Most of the cropland (from 67 to 100 percent) was used to produce grain sorghum on the 11 farm situations with wheat at \$1.06 per bushel and feed grain at \$.94 (Appendix table 7). Those with a hog enterprise (grain-hog and grain-livestock farms) produced the most wheat because May labor was a limiting resource and wheat does not require May labor. The farm situation with a hog enterprise and "no limit" on hired labor increased hog and beef production and did not produce wheat.

Four beef-cattle enterprises (cow-calf, calf-wintered, calf-wintered and summer-grazed, and farm-fed steers) competed for resources on the grain-beef and the grain-livestock situations except in three cases: (1) where "calves wintered" were excluded, the "farm fed steer" enterprise became profitable; (2) where "calves were wintered in drylot" that enterprise and the cow-calf enterprise were profitable; and (3) when a "custom fed steer" enterprise was added, the calves wintered were finished in a custom feed lot.

The hog enterprise on the grain-hog and the grain-livestock farm situations dominated use of the resources including the grain produced.

Wheat at \$1.25 per bushel. With wheat at \$1.25 a bushel and feed grain at \$.94, most cropland was used to produce wheat on five of the farm situations (grain, grain-beef cow, and three of the four grain-beef farms), (Appendix table 8). On the grain-beef farm with the "calf wintered drylot" enterprise added, the cropland was in a sorghum-fallow-wheat rotation except for substantial acreages of sorghum silage and alfalfa hay required as livestock feed. On the other farm situations, crop acreage was similar to that with \$1.06 wheat. There was a small acreage of summer fallow because of a sorghum-fallow-wheat rotation used on land on which wheat was abandoned. That produced some return from sorghum and the summer fallow permits seeding the land back to winter wheat in the fall.



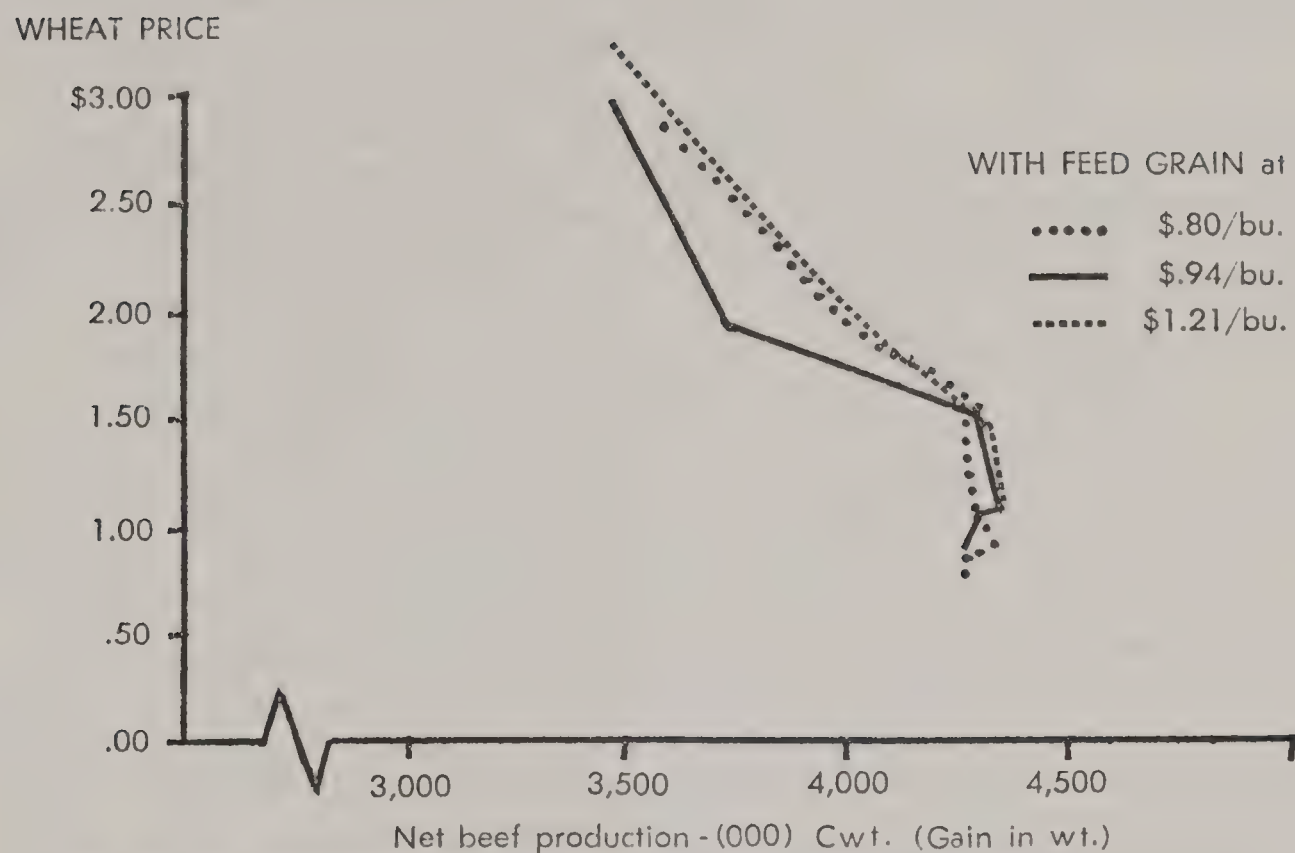


Fig. 3. Aggregate net beef production at various wheat-feed grain prices, Area III.

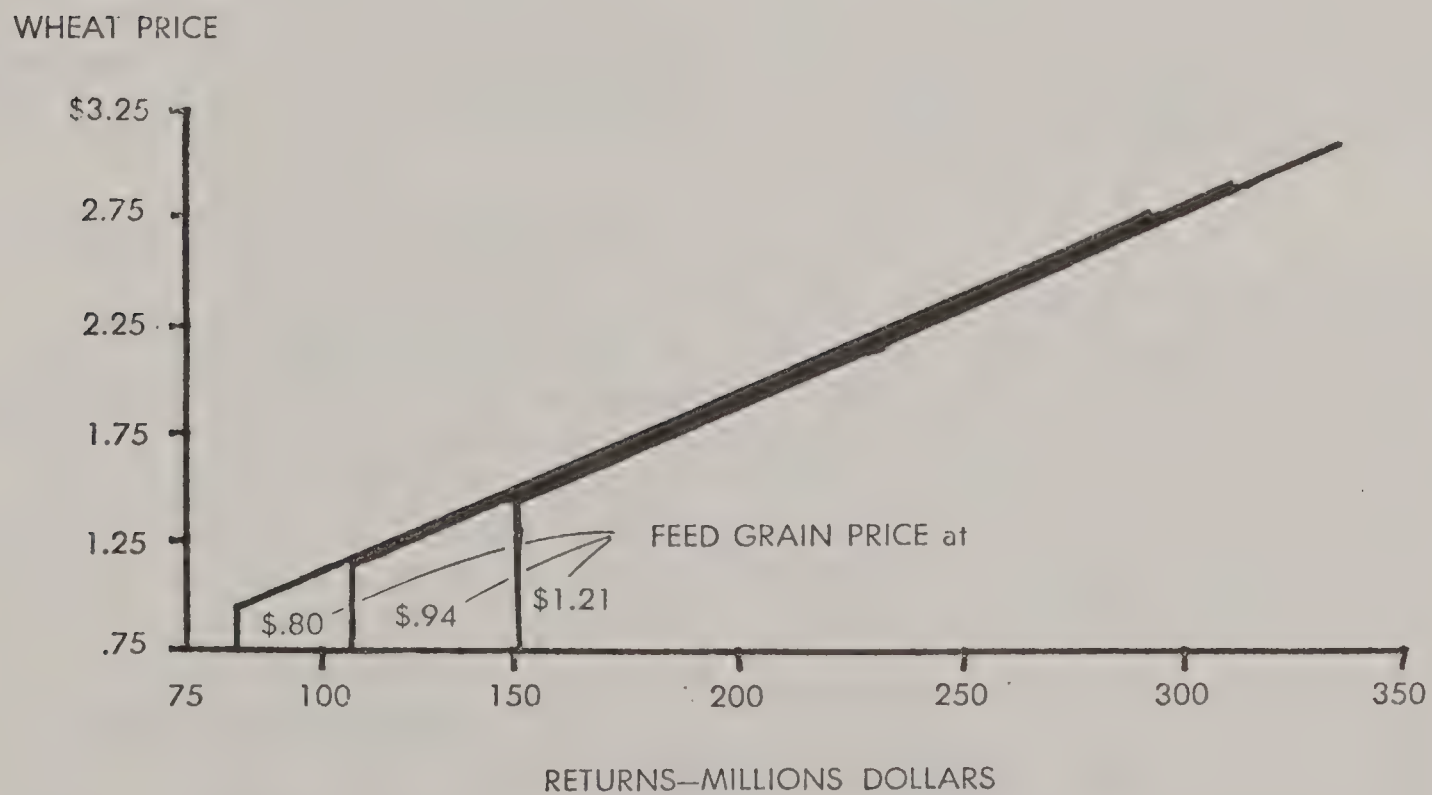


Fig. 4. Aggregate returns to operator's labor, management and fixed cost, at various prices, Area III, West-part Central Kansas.



Livestock enterprises with \$1.25 wheat different little from those with \$1.06 wheat.

Wheat at \$1.81 per bushel. With this favorable wheat price and no controls on wheat production, wheat was produced on all or most of the cropland on the farm situations analyzed except those with a hog enterprise, which continued to produce feed grain for the profitable hog enterprise (Appendix table 9).

On the grain-beef farm with calves wintered in the drylot, most acreage that had been in grain sorghum and also some of the sorghum silage and alfalfa land (with lower wheat prices) were shifted to wheat. Also the cow-calf enterprise was dropped and the number of calves wintered in the drylot decreased about 40 percent (from 318 to 187). The calf-wintered and calf-wintered-and-grazed enterprises were expanded to use the wheat pasture, grain stubble, and native pasture.

On the grain-livestock farms, the wheat price of \$1.81 per bushel increased the wheat and reduced the grain sorghum acreages. The hog enterprise was reduced slightly and the calf-wintered enterprise was expanded to use the increase in wheat pasture.

As the wheat price changed from \$1.06 to \$1.25 and to \$1.81 a bushel, major adjustments in enterprise combinations were made on all farm situations except the grain-hog farm. Feed grain acreages were shifted to wheat. Enterprises in which livestock require large amounts of grain, silage and alfalfa hay in their rations became relatively less profitable as the wheat price increased. Shifts were made to cattle enterprises that would utilize the wheat pasture and other roughages and that would require less grain. Rising wheat prices (to higher than \$1.81 per bushel) eventually would eliminate most enterprises other than wheat and those cattle enterprises which require only pasture and roughage rations. The hog enterprise was not reduced substantially on the grain-hog and grain-livestock farms until wheat reached \$2.40 per bushel.

### Capital and labor requirements

Operating capital required, (on a 12-month basis) varied greatly between farm situations with \$1.25 wheat; it ranged from \$2,035 on the grain farm to \$15,837 on the grain-livestock farm and to \$31,919 on the grain-beef farm with custom fed steers (table 6). The operating capital required for the grain-beef cow and grain-hog farms was three and one half to four times that required for the grain farm. More capital was required on the grain farm as the wheat prices and wheat acreage increased, and as the grain sorghum (which requires less capital) acreage decreased.

Labor requirements increased substantially when livestock enterprises were added to the grain farm, but they were not greatly affected on any one specified farm situation by the wheat price up to \$1.81/bu. With \$1.25 wheat, labor requirements ranged from 831 hours on the grain farm (about a third of the operator's time) to 2,852 hours on the grain-livestock farm. The beef-cow enterprise, when added to the grain farm, increased labor requirements about 40 percent. Adding other beef cattle and hog enterprises to the grain farm increased labor requirements to two and one half to three times that of the grain farm. By adding livestock, the operator can use his labor more efficiently, distributing it through the year (figure 5).



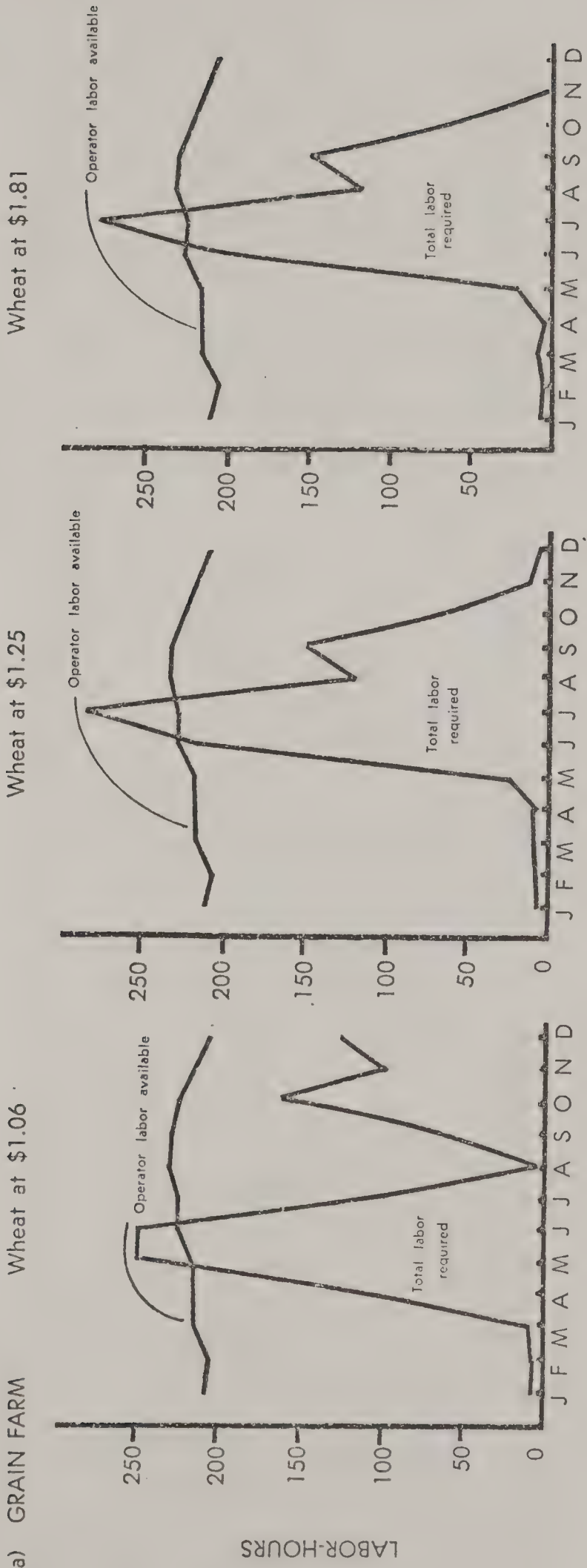
Table 6.- Effects of livestock enterprises on capital and labor needs, and returns,  
901-acre units, with \$.94 feed grain, Area III, Kansas

		Grain-beef				Grain-hog 1/				Grain-livestock			
		: Excl.: +Cust.		: No : \$1.21		: Grain- : No : Sell wheat		: Grain- : No : Sell wheat		: Grain- : No : Sell wheat		: Grain- : No : Sell wheat	
		: Grain-: calf.: wtr. : fed		: Grain- : limit: Feed		: Grain- : limit: labor: stock : labor: grain 2/		: Grain- : limit: labor: stock : labor: grain 2/		: Grain- : limit: labor: stock : labor: grain 2/		: Grain- : limit: labor: stock : labor: grain 2/	
		: beef : wtr. : drylot : steer		: hog : labor: grain		: stock : labor: grain		: stock : labor: grain		: stock : labor: grain		: stock : labor: grain	
		\$		\$		\$		\$		\$		\$	
Operating capital required per farm													
1.06	1,595	7,641	12,060	11,965	27,989	32,118	8,272	8,583	8,314	15,837	16,053	15,837	15,837
1.25	2,035	7,366	12,199	13,386	27,436	31,919	8,272	8,583	8,273	15,837	16,053	15,837	15,837
1.81	2,035	7,320	12,141	10,228	21,952	31,914	8,272	8,477	8,272	15,983	15,983	15,983	15,954
Labor required per farm - operator, hired, (hours)													
1.06 - O	3/1,078	1,442	2,063	1,902	2,378	2,078	2,032	2,104	2,001	2,380	2,334	2,380	2,380
- H	3/59	97	46	48	4/560	124	5/211	309	176	5/472	693	5/472	5/472
1.25 - O	774	1,123	1,843	1,802	2,341	1,889	2,032	2,104	2,032	2,380	2,334	2,380	2,380
- H	57	66	51	90	538	51	5/211	309	211	5/472	693	5/472	5/472
1.81 - O	774	1,124	1,830	1,452	2,240	1,879	2,032	2,094	2,032	2,403	2,403	2,403	2,299
- H	57	66	55	96	354	55	5/211	260	211	345	345	345	331
Returns to operator's labor and management (dollars) 6/													
1.06	-3,904	-4,391	-2,835	-3,548	1,064	-1,380	4,568	5,329	5,560	4,356	5,039	4,356	4,356
1.25	-3,360	-3,849	-1,798	-2,742	1,303	-306	4,746	5,329	5,711	4,576	5,039	4,576	4,715
1.81	1,111	580	2,469	1,450	2,907	3,956	5,268	5,328	6,233	5,353	5,353	5,353	8,237
Returns per hour of operator's Labor (dollars) 7/													
1.06	-3.62	-3.05	-1.37	-1.87	.45	-.66	2.25	2.53	2.78	1.83	2.16	1.83	-1.83
1.25	-4.34	-3.43	-.98	-1.51	.56	-.16	2.34	2.53	2.81	1.92	2.16	1.92	1.98
1.81	1.44	.52	1.35	1.00	1.30	2.11	2.59	2.54	3.07	2.23	2.23	2.23	3.58

1/Unused native pasture rented out at \$4.50 per acre. 2/Wheat can be sold to purchase lower priced feed grains for feeding at \$.10 a bushel above market price. 3/O = operator and H = hired labor. 4/Labor was limiting in September and October. 5/May hired labor was limiting. 6/Returns based on fixed costs of \$10,896 (table 5). 7/Returns to operator's labor and management divided by hours of operator's labor used.



(5.a) GRAIN FARM



(5.b.) GRAIN-BEEF FARM

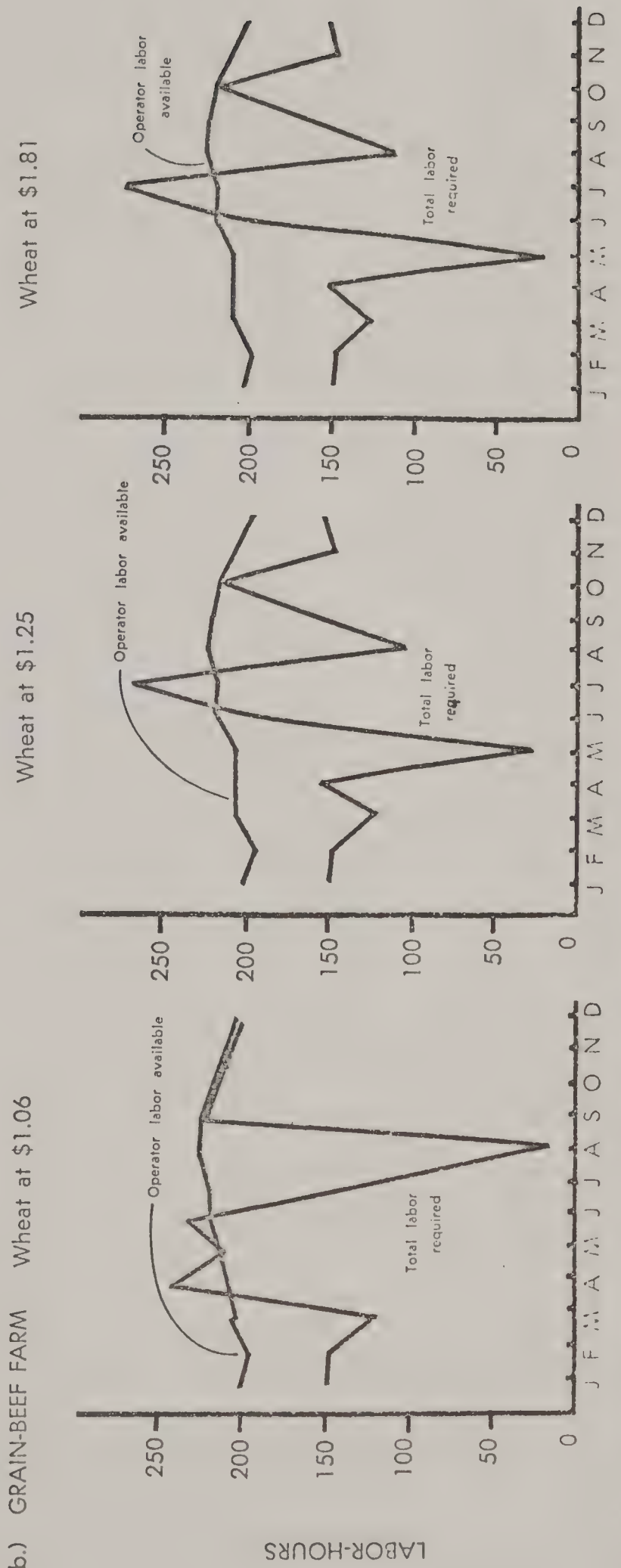
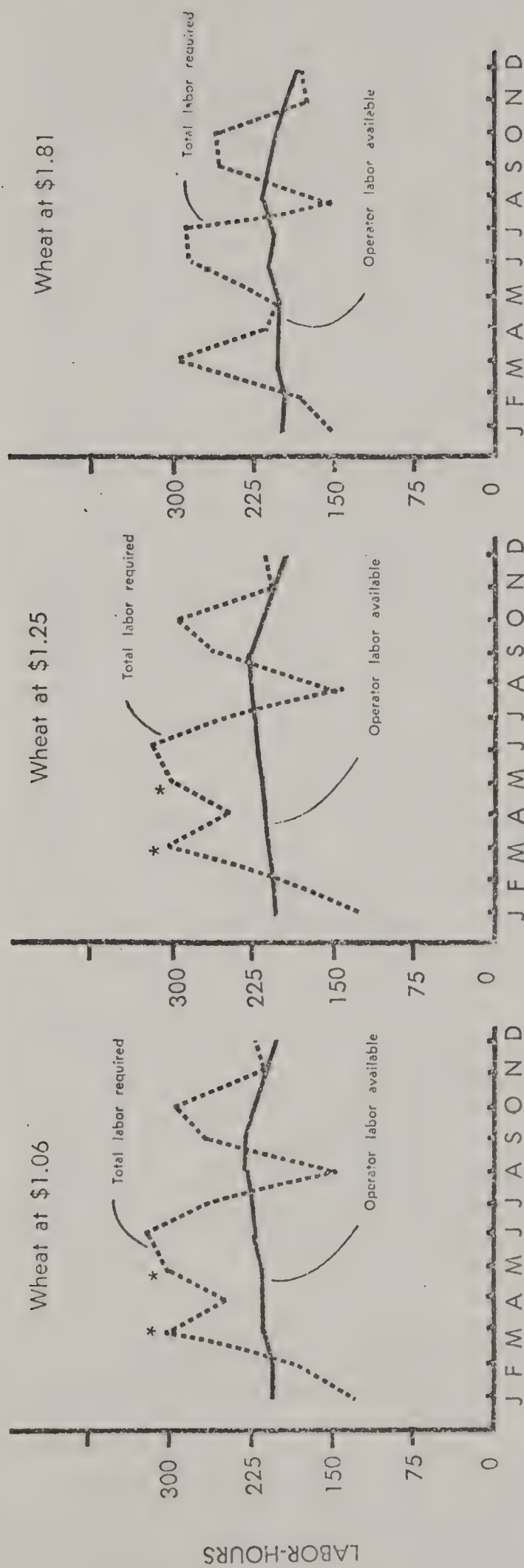


Fig. 5. Operator Labor Available and Total Labor Used, by Month, Specified Farm Situations, Area III, West-part Central Kansas



(5.c.) GRAIN-LIVESTOCK FARM



(5.d.) LARGE GRAIN-BEEF FARM

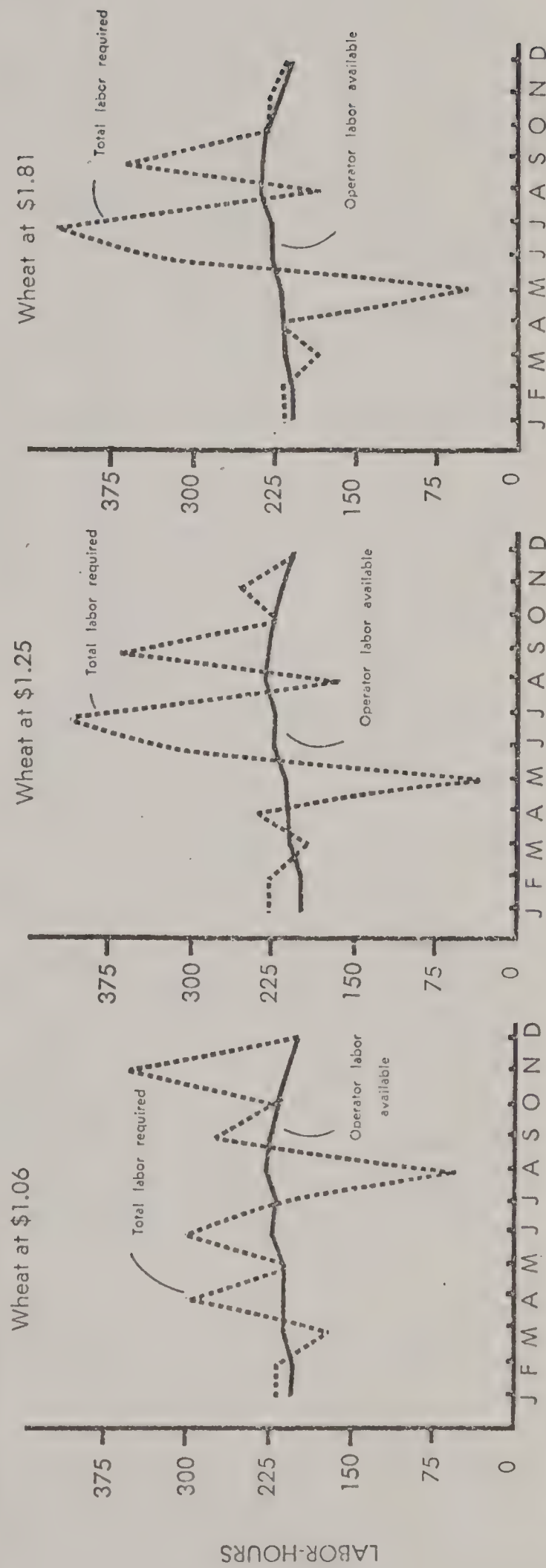


Fig. 5. Operator Labor Available and Total Labor Used, by Month, Specified Farm Situations, Area III, West-part Central Kansas

\* March and May labor limiting (All available operator and hired labor used.)



## Returns to operator

Adding livestock enterprises to the grain farm significantly affected returns to the operator's labor and management (table 6). Wheat prices had little or no effect on returns from the grain-hog and grain-livestock farms, because little or no wheat was produced. On the grain farm, grain-beef cow farm, and grain-beef farms, the \$1.81 wheat increased returns substantially over those received with \$1.25 wheat. With wheat prices at \$1.06 and \$1.25 per bushel, those farms produced returns to operator's labor and management that were either extremely low or negative (failed to cover fixed costs). With \$1.25 wheat, returns to operator's labor and management ranged from -\$3,849 (failed to cover costs) on the grain-beef cow farm to \$4,746 on the grain-hog farm (with hogs priced at \$18.75 per cwt). Hog prices varied sharply in 1969 and 1970. If hogs were priced at \$16.75 per cwt. (the average price), the returns (with \$1.25 wheat and no change in costs) would be \$2,174 on the grain-hog farm and \$2,104 on the grain-livestock farm. But, if hogs were priced at \$20.75/cwt., the returns would increase to \$7,318 on the grain-hog unit and to \$7,048 on the grain-livestock unit.

One of the grain-livestock farms was programmed to sell the wheat produced and to buy feed grain for feeding when profitable (table 6 and Appendix table 10). With wheat at \$1.25 and feed grain at \$.94 per bushel, 1,953 bushels of feed grain were purchased (at \$1.04 a bushel), which increased returns by only \$139 over the grain-livestock farm (which could not purchase feed grain). However, with \$1.81 wheat and \$.94 feed grain, most of the feed grain acreage was shifted to wheat, and 5,144 bushels of feed grain were purchased (at \$1.04 a bushel). With these price relationships, returns were increased from \$5,353 to \$8,237 by selling wheat and buying feed grains. Normally, however, such a price relationships could not be maintained over a period of years in a free market, because feed grain acreage would shift to wheat until demand pushed feed grain price closer to that of wheat.

Returns on the grain-livestock farm and the grain-livestock farm with no limit on available labor were the same when wheat was \$1.81 per bushel. Feed grain, not labor, was the limiting resource on both farms because all feed grain available for feeding was fed.

Returns per hour of operator's labor used ranged from \$.52 on the grain-beef cow farm to \$2.59 on the grain-hog farm, with wheat at \$1.81 (table 6).<sup>9/</sup> With wheat at \$1.06 or \$1.25 per bushel, the only farm situation with reasonably acceptable returns per hour were the grain-hog and the grain-livestock farms, both of which gained most of their income from livestock enterprises.

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<sup>9/</sup>Returns to operator's labor and management divided by hours of operator's labor used.



## Effects of Farm Size on Capital and Labor Requirements and Returns

In recent years, farm operators have been increasing the sizes of their farms either to maintain or to increase their incomes. Economies of size usually are associated with increased farm acreage and increased sizes of machinery. We limited our analysis to increased farm acreage with no changes in the size of farm machines, because available information indicated small differences in sizes of machines on farm sizes studies in Area III.

Three sizes of the grain-beef farm (540, 901, and 1,352 acres) were programmed with feed grain at \$.94 per bushel and wheat at \$1.06, \$1.25 and \$1.81 per bushel. Using the same yields and variable costs per enterprise unit for all three farm sizes, fixed costs per acre decreased slightly as farm size increased (table 5). The organization, labor and capital requirements, and returns for the three alternative farm sizes are summarized in Appendix table 11.

Farm organization was proportionately the same on the small or large farms as on the average grain-beef farm (discussed in preceeding section), with one exception; on the large grain-beef farm, when wheat was \$1.06 per bushel, it was profitable to summer fallow 240 acres (160 in a wheat-sorghum-fallow rotation and 80 in a sorghum-fallow rotation). Those summer fallow rotations were not profitable on any of the three farm sizes when wheat prices were \$1.25 or \$1.81 except when used to replace abandoned wheat.

### Capital and labor requirements

Increasing the size of a farm did require additional operating capital and labor. Both capital and labor requirements varied almost directly with the farm size (table 7). The large farm required only a small amount of hired labor even though hired labor was not limited. The price of wheat had relatively little effect on either capital or labor requirements on the grain-beef farm. For example, the large grain-beef farm used all or most of the operator's labor in 10 months with \$1.06 wheat and in 9 months with \$1.25 or \$1.81 wheat (figure 5d).

### Returns to operator

Total fixed costs (land and overhead) varied with farm size. The major fixed cost, land, varied directly with farm acreage, but fixed costs for building and improvements, pickup, auto, and miscellaneous items were changed little. Thus, fixed costs per acre decreased somewhat as the size of farm increased (table 5).

When wheat prices were low, farm size did not significantly affect returns to operator's labor and management. Those returns failed to cover costs (fixed and variable) for any of the three farm sizes when wheat was \$1.06 or \$1.25 per bushel. Even with wheat at the favorable price of \$1.81 per bushel, returns to operator's labor and management were quite low on the small farm (\$649), relatively low on the average farm (\$2,469), and barely adequate on the large farm (\$4,503, table 7). The small farm, (60 percent of the size of the average farm) produced only 26 percent as much return as did the average. However, the large farm (50 percent larger than the average) produced 82 percent more



Table 7--Effects of farm size on capital and labor needs, and returns, grain-beef farms, with \$.94 feed grain,  
Area III, Kansas

Wheat price	: Small (540 acre)	: Average (901 acre)	: Large (1,352 ac.)
<u>\$/bu.</u>	<u>\$</u>	<u>\$</u>	<u>\$</u>
<u>Operating capital required per farm (dollars)</u>			
1.06 . . . . .	7,245	12,060	17,298
1.25 . . . . .	7,316	12,199	18,303
1.81 . . . . .	7,281	12,141	17,659
<u>Labor required per farm-operator, hired (hours) <u>1/</u></u>			
1.06 - operator . . . . .	1,321	2,063	2,345
- hired . . . . .	0	46	379
1.25 - operator . . . . .	1,135	1,843	2,299
- hired . . . . .	0	51	531
1.81 - operator . . . . .	1,130	1,830	2,301
- hired . . . . .	0	55	440
<u>Returns to operator's labor and management (dollars) <u>2/</u></u>			
1.06 . . . . .	-2,464	-2,835	-3,811
1.25 . . . . .	-1,911	-1,798	-2,021
1.81 . . . . .	649	2,469	4,503
<u>Returns per hour of operator's labor (dollars) <u>3/</u></u>			
1.06 . . . . .	-1.87	-1.37	-1.63
1.25 . . . . .	-1.68	-.98	-.88
1.81 . . . . .	.57	1.35	1.96

1/Hired labor was not limited on the large farm. 2/Based on fixed costs of \$7,404, \$10,896 and \$15,066 for small, average, and large farms respectively (table 5). 3/Returns to operator's labor and management divided by hours of operator's labor used.



returns with wheat at \$1.81. Only with the high wheat price (\$1.81 per bushel) did it pay to increase farm size in Area III. In recent years, government programs restricting acreages and the cost-price squeeze have made it necessary for farmers to increase their farm sizes in order to maintain reasonable incomes. An additional incentive to enlarge farms has been the expectation of further increases in land values. <sup>10/</sup>

### Effects of Crop Yields on Capital and Labor Requirements and Returns

Over time, average crop yields on many farms differ from the area average, resulting from many factors, including differing levels of technology and management. Management, which is difficult to measure or to characterize, selects enterprises, kinds and varieties of crops, the level of adoption of each farming practice, and timing of operations, including the buying and selling activities.

To illustrate the effects of differences in the level of crop yields on capital and labor requirements and returns, we programmed three levels of crop yields for the average grain-beef farm, with feed grains at \$.94 and wheat at \$1.06, \$1.25, and \$1.81 per bushel. Yields at 20 percent below average, average, and 20 percent above average for the area were specified for all crops, including wild hay and native pasture. (Those yield differences are comparable with observed differences on individual farms and for groups of farms described as low-income, average-income, and high-income farms in Farm Management Associations in Area III.) Variable costs for crop enterprises were appropriately reduced or increased to reflect changes in farming practices associated with specified low yields and high yields.

The organization, labor and capital requirements, and returns for the three alternative crop yields are summarized in Appendix table 12. Farm organization on these grain-beef farms was not affected by the level of crop yields, except when wheat was priced at \$1.06 per bushel, with feed grain at \$.94. With that price combination a substantial acreage of wheat was grown on the farm with low crop yields, but as yields were increased the acreage of grain sorghum increased, completely replacing wheat on the farm with high crop yields.

### Capital and labor requirements

Crop yields affected operating capital and labor requirements. The change of 20 percent from the average crop yield, either lower or higher, resulted in a 15 percent change in the operating capital requirement at all three wheat prices (table 8). Some of that difference in capital requirement resulted from a change in crop inputs, but most can be attributed to the change in livestock numbers that resulted because of the different production levels.

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<sup>10/</sup>Land values have been increasing in Kansas during the past 25 to 30 years, substantially during the past 10. For example, average land values for the state increased 64 percent from 1957 to 1967, an average of 6.4 percent annually. Otto, Merton L. and J.E. Pallesen, Trend in Land Values in Kansas, Kans., Agr. Expt. Sta. Bull. 521, Jan. 1969.



Table 8--Effects of crop yields on capital and labor needs,  
901-acre grain-beef farm, with \$.94 feed grain,  
Area III, Kansas

Wheat price \$/bu.	: : :	Low yield 1/ \$	: : :	Average yield \$	: : :	High yield 1/ \$
<u>Operating capital required per farm (dollars)</u>						
1.06 . . . . .	:	10,351	:	12,060	:	13,805
1.25 . . . . .	:	10,348	:	12,199	:	14,049
1.81 . . . . .	:	10,300	:	12,141	:	13,980
<u>Labor required per farm operator, hired (hours)</u>						
1.06 - operator . . . . .	:	1,846	:	2,063	:	2,100
- hired . . . . .	:	0	:	46	:	251
1.25 - operator . . . . .	:	1,686	:	1,843	:	1,989
- hired . . . . .	:	54	:	51	:	51
1.81 - operator . . . . .	:	1,685	:	1,830	:	1,975
- hired . . . . .	:	55	:	55	:	55
<u>Returns to operator's labor and management (dollars) 2/</u>						
1.06 . . . . .	:	-5,089	:	-2,835	:	-584
1.25 . . . . .	:	-4,018	:	-1,798	:	419
1.81 . . . . .	:	-594	:	2,469	:	5,529
<u>Returns per hour of operator's labor (dollars) 3/</u>						
1.06 . . . . .	:	-2.76	:	-1.37	:	-.28
1.25 . . . . .	:	-2.38	:	-.98	:	.21
1.81 . . . . .	:	-.35	:	1.35	:	2.80

1/ Low yields, 20% below, and high yields, 20% above average.

2/ Based on fixed costs of \$10,896 (table 5).

3/ Returns to operator's labor and management divided by  
hours of operator's labor.



Total labor requirements were changed by only 8 to 13 percent (mostly harvest labor) in response to the 20 percent change in crop yields. With wheat at \$1.25, labor needs were 1,686 hours for low, 1,989 hours for high, and 1,843 hours for average yields. About the same amounts of labor were required with wheat at \$1.81. They were slightly higher with wheat at \$1.06.

### Returns to operator

Varying crop yields by 20 percent, on either side of the area average, significantly affected the operator's returns (table 8). With \$1.06 wheat, even the farm with high yields did not produce enough income to pay all costs. With wheat at \$1.25, the farm with high yields produced a return to operator's labor and management of only \$419, and the one with low yields lacked \$4,018 of paying all costs. The difference between those returns was \$4,437. Even with \$1.81 wheat, the farm with average yields produced the relatively low return of \$2,469 to operator's labor and management. High yields boosted the return to \$5,529. Increasing crop yields on the grain-beef farm by 20 percent above the area average was substantially more rewarding than increasing the farm size by 50 percent. Also, it should be noted that the reward was much greater with the lower than with the higher wheat price tested. These figures clearly illustrate the great potential payoff from better management.

### Effects of Increasing Prices of Wheat, Feed Grain and Beef Simultaneously on Organization, and Returns

Prices of wheat, feed grains and beef cattle occasionally move in the same direction at the same time, therefore, that type of situation was programmed on the 901-acre grain-beef farm, with prices varied parametrically within this range: wheat \$.89 to \$2.09/bu.; feed grain, \$.94 to \$1.54/bu.; and beef cattle, \$15.20 to \$39.34/cwt. As in preceeding analyses, production costs remained constant except for livestock. Those varied as the price of feeds produced and fed on the farm changed.

### Farm organization

Farm organization changes significantly at price combinations shown in table 9. Up to \$1.71 wheat, \$1.08 feed grain, and \$20.52 beef, it was more profitable to produce feed grain for sale than to feed even small quantities to cattle. All cropland was used to produce sorghums until wheat reached \$1.38 per bushel. Some wheat production entered the organization with \$1.38 wheat, \$1.19 feed grain, and \$26.54 beef. Maximum wheat and minimum sorghum acreages were produced with \$1.81 wheat and \$34.19 beef. At those prices, all feed grain available for feeding was fed to steers being fattened. When the price of beef reached \$39.34 per cwt., it became profitable to reduce the wheat acreage from 371 to 314 acres (even with \$2.09 wheat) and to increase the grain sorghum and the number of fed steers. About 155 head of calves were wintered to use the farm-produced roughage when wheat was \$1.33 to \$2.09 per bushel.



Table 9--Effects of increasing prices of wheat, feed grain, and beef cattle simultaneously on organization and returns, 901-acre grain-beef farm, Area III, Kansas 1/

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1/Wheat, feed grain and beef cattle prices were parametrically programmed simultaneously with the range of prices shown. Significant farm organization changes occur at the wheat prices shown.  
2/Fixed costs are \$10,896 (table 5).



### Returns to operator

As expected, returns increased as commodity prices increased, but they did not pay all costs until prices were slightly above \$1.38 for wheat and \$26.54 for beef. With wheat at \$1.75 and beef at \$33.67 returns to the operator were \$4,489. This return more than doubled with less than a 20 percent increase in the prices of wheat and beef--with \$2.09 wheat and \$39.34 beef, returns amounted to \$9,601.

### Implications for Area III

Feed grain, especially grain sorghum, was a good alternative for wheat in Area III when wheat prices were low. Either crop can be produced with essentially the same set of equipment. Wheat began to show up in the farm organization when its price was 10 to 15 percent above the feed grain price (corn equivalent price). When it reached 20 to 27 percent above, most of the feed grain acreage was shifted to wheat production. The Agricultural Acts of 1970 and 1973 permit substitution of wheat and feed grains, allowing greater flexibility and shifts in patterns of production than was possible under earlier commodity programs. Farm operators may select the most profitable (based on expected market prices) of those crop enterprises.

Net returns to farm operators for their labor and management are of crucial interest both to farmers and to nonfarmers in rural communities in which they live. This study indicated that in Area III most farms of average size or smaller (except those on which hogs are a major enterprise) will not produce enough income to pay all costs (variable and fixed) and leave a return for the operator, when feed grain is \$.94 and wheat \$1.25 a bushel. Wheat and feed grain prices and assumed prices for livestock used in the study approximate "market price" levels observed in recent years (prior to August 1972). That would indicate that government-program payments may have provided many farm operators with enough additional income to postpone financial difficulty or even to make a reasonable return for labor and management.

If land prices do not go down significantly and recent market prices prevail (without price supports), we can expect that most average size farms in Area III will produce low returns. The equity position of individual farmers also will determine how serious low returns may be, because most interest costs on investments are "opportunity costs" for operators with high equities instead of cash costs to be paid out of returns by those with low equities. Interest on the operator's investments also might be available for living expenses.

Without either higher average "market prices" for grain or government price supports (such as those under the 1970 act), many operators would need to adjust their operations to increase income. Three major adjustment alternative are to: market crops through livestock when livestock prices are favorable; increase farm size; or increase crop yields through better management.



Adding or expanding livestock enterprises on farms in Area III would be encouraged by low grain prices. A growing demand for meat, in addition to low grain prices, should make grain feeding enterprises profitable. This study indicated that hogs were more profitable than farm fed steers on the situations studied. The higher net returns on those farm situations analyzed were produced by feeding grain to hogs.

Increasing farm size in Area III is another way to increase incomes of grain-beef farms--but only if the wheat price is \$1.50 per bushel or higher. Many operators in the area could use their present equipment and labor to handle more land. With low wheat prices (such as might be expected with no government-price supports), increasing the size of the grain-beef farms is not likely to increase the operator's returns. On farms with a profitable livestock feeding enterprise, the price of wheat would have little effect on returns, since little wheat is produced. Thus, operator's returns on such farms could be increased by increasing farm size. For the area, increasing farm size means fewer farms, but larger incomes to those operators with larger units. Gross farm income, total labor requirements, and operating capital requirements for the area probably would not change materially.

Increasing crop yields through improved management practices is another, and probably the most efficient and effective, way to increase farm income. That alternative increases aggregate production of crops and provides the potential for increased livestock production without reducing farm numbers in the area. Increasing yields would produce more gross income, use more inputs, and increase net returns, both on individual farms and for the area, provided increased production would not reduce prices significantly.

Production and returns for most farms in Area III could be increased by one or more of the alternative adjustments. The effects on the area, however, might differ. Increasing farm size could increase returns to individual farmers without substantially affecting aggregate production, input requirements, or returns for the area. That would cause a further decline in the number of farm families in the area. Increasing crop yields and adding more livestock would increase production, both on the farm and in the area. If farmers in other areas made similar adjustments, however, it could be self-defeating if the increased production is sufficient to depress prices.

By increasing his farm size or by adding livestock, the operator can make greater use of his labor. Operators unable to hire seasonal labor in the area during periods of peak labor needs, and unable to put in more hours themselves, must make alternative adjustments. Applying better management to increase crop yields would be such an adjustment.



## APPENDIX

## Enterprise Data--Variable Costs

Crop enterprises

Potential crop enterprises, yields, fertilizer costs, and variable costs for three levels of technology are shown for Area III in Appendix table 1. Area average yields were estimated for 1970 on the basis of recent trends and average technology. Based on observed differences in yields and technology on individual farms, enterprise budgets also were developed with low yields (20% below average) and with high yields (20% above average). Fertilizer and other variable costs were adjusted to reflect the different levels of technology represented by the yields.

Variable costs included the costs of seed, fertilizer, pesticides all machine costs (including operating and ownership costs), hired labor, custom hired operations, and interest on operating capital. Since an intermediate length of run (time horizon) was assumed, all costs of machinery (both variable and fixed) were considered variable costs in preparing enterprise budgets. To determine the ownership costs of machinery we calculated the annual costs of depreciation, interest on investment, and taxes for a typical machinery inventory for the average size farm in Area III. "Average investment" was \$14,447 and major items included: 2.2 tractors (48 and 36 HP), 2 moldboard plows, 1.4 oneways, 1.2 field cultivators, .6 rod weeder, .6 tandem disk, 1 harrow, 1 grain drill, 1 combine 14', 1.2 trucks (2-ton), and .7 pickup, (based on unpublished data from farm survey). The costs were allocated to the individual enterprises on the basis of use, determined from typical operations required and average performance rates of the machinery. For rotations (such as wheat-fallow, wheat-wheat-fallow, or wheat-sorghum-fallow) variable costs included the costs of both crops and summer-fallowing.

Operating capital required includes only costs incurred prior to harvest because harvesting costs usually are net from crop sales. Labor needs were specified by month or period for each enterprise budget.

Wheat pasture and sorghum stubble pasture were available when wheat and grain sorghum were grown. Rye and sudan pasture were planted on cropland for the hog enterprise. Native pasture included the wild hay acreage. The largest reported acreage cut in each county, between 1945 and 1965, represented the maximum potential for wild hay. For Area III, that was 40,000 acres, or an average of 3 acres on the average 901-acre farm. (When wild hay was cut, native pasture acreage was reduced.) On the grain farm and the grain-hog farm, native pasture was not used, so it was rented out at \$4.50 per acre.

Livestock enterprises

Variable costs for livestock enterprises include: purchased feed (protein supplement, salt, and minerals); veterinary service; all costs of machinery and transportation; and interest on operating capital (Appendix table 2). As with crops, ownerships costs of machinery and facilities required for livestock were allocated to the livestock



Appendix table 1--Crop enterprises - yields, fertilizer costs, variable costs, labor required, for three levels of technology 1970, Area III, Kansas

Crop enterprise	Unit	Yields, planted acre 1/			Fertilizer costs			Variable costs 2/			Labor	
		Low	Average	High	Low	Average	High	Low	Average	High	required	required
					\$	\$	\$	\$	\$	\$	Hrs.	Hrs.
1. Wheat, cont. . . . .	Bu.	12.6	15.7	18.8	1.34	1.91	2.48	8.19	8.86	9.53	1.51	1.51
2. Wheat-wheat-fallow 3/ . . .	"	30.8	38.4	46.0	3.06	4.37	5.68	18.63	20.16	21.70	3.46	3.46
3. Wheat-fallow 4/ . . . . .	"	16.6	20.7	24.8	1.72	2.46	3.20	10.43	11.30	12.17	1.95	1.95
4. Fallow-wheat- 3/ . . . . .	"	15.8	19.7	23.6	1.34	1.91	2.48	8.19	8.86	9.53	1.51	1.51
-sorghum . . . . .	"	28.0	35.0	42.0	3.20	4.57	5.94	22.86	24.63	26.40	4.17	4.17
5. Barley(wtr.), cont. . . . .	"	10.2	12.8	15.4	.79	1.13	1.47	6.91	7.33	7.76	1.39	1.39
6. Barley(wtr.), fallow 4/ . . .	"	13.7	17.1	20.5	1.06	1.51	1.97	8.93	9.48	10.05	1.81	1.81
7. Sorghum, cont. . . . .	"	20.2	25.2	30.2	1.21	1.73	2.25	11.41	12.13	12.86	2.13	2.13
8. Sorghum-fallow 4/ . . . . .	"	32.1	40.1	48.1	1.73	2.48	3.23	14.92	16.00	17.09	2.79	2.79
9. Sorghum on aband.wht.cont.	"	25.6	32.0	38.4	2.68	3.83	4.98	20.71	22.24	23.77	3.74	3.74
-fallow-wheat 3/ 5/ . . . . .	"	15.8	19.7	23.6	1.34	1.91	2.48	8.19	8.86	9.53	1.51	1.51
10. Sorghum on aband.wht.fal.	"	30.2	37.7	45.2	2.68	3.83	4.98	20.65	22.19	23.73	3.72	3.72
-fallow-wheat 3/ 5/ . . . . .	"	15.8	19.7	23.6	1.34	1.91	2.48	8.19	8.86	9.53	1.51	1.51
11. Sorghum silage . . . . .	Ton	6.72	8.40	10.08	2.00	2.85	3.70	17.47	19.02	20.57	4.78	4.78
12. Sorghum forage (bundle) . .	"	1.92	2.40	2.88	1.61	2.30	2.99	14.37	15.67	16.93	7.43	7.43
13. Sudan hay (bale) . . . . .	"	1.56	1.95	2.34	.97	1.38	1.80	21.10	24.18	27.28	4.90	4.90
14. Alfalfa hay (bale) 6/ . . .	"	9.60	12.00	14.40	1.23	1.76	2.29	109.94	126.29	142.65	31.48	31.48
15. Wild hay (bale) . . . . .	"	.96	1.20	1.44	0	0	0	8.63	10.45	12.21	2.58	2.58
16. Sudan (hog past.) . . . . .	AUM 7/	1.52	1.90	2.28	.97	1.38	1.80	7.17	7.60	8.03	1.24	1.24
17. Rye (hog past.) . . . . .	"	.88	1.10	1.32	.94	1.35	1.76	6.02	6.45	6.89	1.03	1.03
18. Native pasture . . . . .	"	.52	.65	.78	0	0	0	(Included in Livestock enter- prises.)				

1/Wheat and barley yields reduced .8 and 1.4 bushel, respectively, to adjust for homegrown seed used. 2/Includes fertilizer and all machinery costs. Excludes fixed costs: land, buildings, pickup, auto, and misc. items  
3/A 3-acre enterprise. 4/A 2-acre enterprise. 5/Sorghum on abandoned wheat (cont. or fallow), followed by summer fallow, then planted to wheat. 6/Seeded on fallow, 5 years stand. 7/Animal unit month = pasture required by mature cow for one month.



Appendix Table 2 --Livestock enterprises - Variable costs, operating capital, labor requirements and rations, 1970, Area III, Kansas

Enterprise										
:Ra- :tion: :No.	: Vari- : able : costs	: Operat- : ing : capital	: Labor: : req.	: Feed : grain	: Ration					
					: Protein : suppl.	: Wheat : pasture	: Silage	: Hay	: Nat.&stub. : pasture	
	\$	\$	Hrs.	Cwt.	Cwt.	AUM	Ton	Ton	AUM	
Cow-calf 3/	1	54.97	235	15.0	-	1.5	2.1	2.03	-	10.0
	2	54.97	235	15.0	-	1.5	2.1	-	.68	10.0
	3	59.17	235	15.0	-	2.7	-	-	.68	11.9
	4	59.17	235	15.0	-	2.7	-	2.03	-	11.9
Calf, wint	1	24.93	130	6.5	2.0	1.0	1.05	.81	-	1.07
	2	24.93	130	6.5	2.0	1.0	1.05	-	.27	1.07
	3	27.83	133	6.5	3.6	1.8	-	.81	-	1.93
	4	27.83	133	6.5	3.6	1.8	-	-	.27	1.93
Calf, wintered	1	31.27	135	3.5	7.2	2.3	-	3.00	-	-
in drylot	2	22.80	127	3.5	7.2	-	-	2.20	4/.45	-
Calf, wint	1	34.10	133	10.0	-	1.0	1.05	.95	-	4.06
	2	34.10	133	10.0	-	1.0	1.05	-	.32	4.06
summer grazed	3	37.32	136	10.0	-	1.8	-	-	.32	4.96
	4	37.32	136	10.0	-	1.8	-	.95	-	4.96
Steer, Fed on farm	1	53.31	198	7.8	27.3	3.6	-	-	.18	-
	2	51.12	196	7.8	22.5	3.0	.60	.60	-	.19
	3	40.17	185	7.8	20.7	0	.60	.38	4/.45	.19
Steer, to cust. lot	1	94.25	255	.3	36.43	(All feed or 23.5# per day for 155 days)				
Sow (2 litters) 5/	1	224.32	226	32.0	105.3	21.6	-	-	4/.42	6/.40

1/ Includes costs of: protein suppl., salt, and minerals: veterinary service and drugs, machinery and facilities used; taxes, depreciation and insurance on livestock; marketing and transportation; and interest on operating capital. Excludes costs of feed produced on farm and fixed costs (table 5)

2/ On a 12 month basis. 3/ Enterprise unit is 1/25 of a 25 cow cowherd (25 cows, 22 calves, 4 replacement heifers, 1 bull). 4/ Alfalfa hay only. 5/ Enterprise unit is 1/20 of the following: 20 sows, 300 pigs raised, and 1 boar (30 gilts bred to replace culled sows and gilts ) Boar purchased and sold yearly. 6/ Rye and sudan pastures (fall and spring litters).



enterprises. Costs of feed produced and fed on the farm were not included in those variable costs listed, but were accounted for in determining net returns for the farm. Operating capital was made up of operating costs incurred prior to marketing the animals plus the capital invested in breeding herds and in purchased livestock. Labor requirements were specified by month or period for each enterprise.

Cattle enterprises use native pasture and other farm-produced roughages. To permit cattle enterprises to enter farm plans under a wide range of crop combinations, several rations were provided for each enterprise. The cow-calf, calves-wintered, and calves-wintered-and-summer-grazed enterprises each have four possible rations. Each ration included pasture, protein supplement, and either silage or hay for use during severe winter weather. Only two of the four rations included wheat pasture. The rations for wintered calves included small amounts of grain. Calves wintered in drylot had two rations.

Steers fed on the farm had three possible rations, sows had only one. Protein supplement, large quantities of grain, and small amounts of roughage were used in both enterprises. Two of the steer-fed rations included wheat pasture for 30 days at the start of the feeding period. The other steer ration included alfalfa hay instead of protein supplement. Grain in the steer-fed rations was limited to a maximum of 50% wheat to avoid digestion problems.

For convenience in programming, feed grain crops were converted to a standard feed grain unit, equal to the feed value of one bushel of corn (Appendix table 3). Silage crops were converted to a corn-silage

Appendix table 3.--Index of feed values for grains and factors to adjust yields to feed grain units 1/

Grain	: Index of : feed value : (per pound)	: Pounds : per : bushel	: Factor for : feed grain : unit
Corn -----	: 1.00	: 56	: 1.0000
Sorghum grain -----	: 0.95	: 56	: 0.9500
Barley -----	: 0.90	: 48	: 0.7714
Oats -----	: 0.90	: 32	: 0.5143
Wheat -----	: 1.05	: 60	: 1.1250

1/ Feed grain unit is equivalent in feed value to one bushel of corn.



equivalent. Corn silage was given an index of 1.0; sorghum silage, 0.95. Dry roughage enterprises (forage sorghum, wild hay and alfalfa hay) were converted to an alfalfa-hay feed equivalent. Alfalfa hay was given a feed-value index of 1.0; wild hay, 0.9; and dry forage sorghum, 0.5. (Alfalfa hay could be fed separately or in combination with other dry roughages.)

Each livestock enterprise is summarized below. (Weight of animals sold represent net weight marketed after death-loss and shrinkage);

1. Cow-calf. Beef cows produced a 430-pound calf for the September market. Cull cows were sold at 1,000 pounds in November. Net production per cow averaged 310 pounds of calf and 120 pounds of cull cow, based on a typical cow herd of 25 cows, 22 calves, 4 heifers, and 1 bull. Cows were on pasture 10 to 12 months a year and fed protein supplement during winter.
2. Calves-wintered. Feeder calves weighing 430 pounds were either produced on the farm or purchased in October, wintered on roughages and 2 pounds of grain daily when not on wheat pasture, and sold in April as 637-pound feeder calves.
3. Calves, wintered in drylot. Feeder calves weighing 430 pounds were either produced on the farm or purchased in October, wintered in a drylot on silage and four pounds of grain daily with either alfalfa or protein supplement, and sold in April as 725-pound feeder steers.
4. Calves, wintered and summer grazed. Feeder calves weighing 430 pounds were either produced on the farm or purchased in October, wintered on roughages and protein supplement (no grain), grazed through the summer, and sold in September as 731-pound feeder steers.
5. Steers fed on farm. Feeder steers weighing 680 pounds were purchased in October, fed grain 5 to 6 months, and sold in April as 1,075-pound "good" slaughter steers.-- OR Feeder steers (from calves wintered and grazed on this farm) weighing 731 pounds in September were fed grain 5 to 6 months and sold in April as 1,126-pound "good" slaughter steers.
6. Steers, to custom lot. Calves (wintered on this farm) weighing 640 pounds in April were sent to a custom feedlot, fattened, and sold at 1,040 pounds in September.
7. Sow (2 litter/yr.). The hog enterprise was based on a 20-sow unit with 2 litters a year, and 7.5 pigs per litter. Butcher hogs were sold at 220 pounds in March and September. Cull gilts and cull sows were sold at 290 pounds and 370 pounds, respectively, in January and July. Feed grain, protein supplement, and alfalfa hay made up the ration. The 20 sow unit included 1 boar and 30 replacement gilts each year.



Appendix table 4 --Effects of wheat price on organization and returns of 901 acre grain-beef farm, with feed grain at \$.80, Area III, Kansas

		Organization and returns with wheat price at <u>1/</u>						
Item	: Unit:	\$ .75	\$ .87	\$ .90 <u>2/</u>	\$ 1.12	\$ 1.54	\$ 1.89	\$ 2.86
<u>Crop enterprise</u>								
Wheat . . . . .	: Ac.:	0	43	123	485	486	487	502
Sorghum, grain . . . . .	: "	465	435	395	33	33	33	21
Sorghum, silage . . . . .	: "	16	16	16	16	14	13	11
Alfalfa hay . . . . .	: "	0	0	0	0	0	0	0
Fallow . . . . .	: "	53	43	8	33	33	35	21
Wild hay (native past.) . . . . .	: "	0	0	0	0	3	3	3
Native pasture(available) . . . . .	: "	340	340	340	340	337	337	337
<u>Production</u>								
Wheat . . . . .	: Bu.	0	845	1,964	7,748	7,768	7,784	7,961
Feed grain(corn equiv.) . . . . .	: Bu.:	11,888	10,811	9,517	1,021	1,024	1,026	643
Beef (net gain) . . . . .	: Cwt.:	318	319	324	320	318	300	268
<u>Livestock enterprise</u>								
Cow-calf . . . . .	: Cows:	0	0	0	0	0	0	0
Calf wintered . . . . .	: No.:	154	154	157	155	154	133	98
Calf winter & sum.graze . . . . .	: "	0	0	0	0	0	8	22
Farm fed steers . . . . .	: "	0	0	0	0	0	0	0
Labor used - operator . . . . .	: Hrs.:	2,040	2,048	2,084	1,832	1,830	1,769	1,653
- hired . . . . .	: Hrs.:	58	41	39	55	55	58	68
Operating capital(12 mo.) . . . . .	: Dol.:	12,034	11,878	12,111	12,202	12,141	11,773	11,122
<u>Returns to operators: 3/</u>								
Lab.,mgt.,fixed costs . . . . .	: Dol.:	6,522	6,530	6,542	8,064	11,222	13,931	21,499
Labor & management . . . . .	: Dol.:	-4,374	-4,366	-4,354	-2,832	326	3,035	10,603

1/Significant changes in farm organization occur at the wheat prices shown or enterprises enter or leave organization. 2/Feed grain equivalent price. 3/Fixed costs are \$10,896 (table 5).



Appendix table 5 --Effects of wheat price on organization and returns of 901 acre grain-beef farm, with feed grain at \$.94 bushel, Area III, Kansas

Item	Organization and returns with wheat price at 1/							
	\$ .89	\$1.062/	\$1.10	\$1.16	\$1.46	\$1.53	\$1.89	\$2.98
<u>Crop enterprise</u>								
Wheat . . . . .	0	40	233	474	485	486	487	506
Sorghum, grain . . . . .	466	443	285	44	33	33	33	17
Sorghum, silage . . . . .	16	16	16	16	16	14	13	11
Alfalfa hay . . . . .	0	0	0	0	0	0	0	0
Fallow . . . . .	52	38	16	33	33	33	34	17
Wild hay (native past.) . . . . .	0	0	0	0	0	3	3	3
Native pasture(available) . . . . .	340	340	340	340	340	337	337	337
<u>Production</u>								
Wheat . . . . .	0	644	3,720	7,581	7,748	7,768	7,784	8,018
Feed grain(corn equiv.) . . . . .	11,899	11,118	6,938	1,267	1,021	1,024	1,026	518
Beef (net gain) . . . . .	318	320	323	320	320	318	278	258
<u>Livestock Enterprise</u>								
Cow-calf . . . . .	0	0	0	0	0	0	0	0
Calf wintered . . . . .	154	155	156	155	155	154	133	87
Calf winter & sum. graze . . . . .	0	0	0	0	0	0	8	26
Farm fed steers . . . . .	0	0	0	0	0	0	0	0
Labor used - operator . . . . .	2,042	2,063	2,044	1,843	1,832	1,830	1,769	1,615
- hired . . . . .	60	46	7	51	55	55	58	72
Operating capital (12 mo.) . . . . .	12,035	12,060	12,139	12,199	12,202	12,141	11,773	10,910
<u>Returns to operators</u>								
Lab.,mgt., fixed costs <sup>3/</sup> . . . . .	8,049	8,061	8,142	8,384	10,667	11,238	13,981	22,505
Labor & management . . . . .	-2,847	-2,835	-2,754	-2,512	-229	342	3,085	11,609

1/Significant changes in farm organization occur at the wheat prices shown or enterprises enter or leave organization. 2/Feed grain equivalent price. 3/Fixed costs are \$10,896 (table 5).



Appendix table 6 --Effect of wheat price on organization and returns of 901-acre grain-beef farm, with feed grain at \$1.21 bushel, Area III, Kansas

Item	:	:	Organization and returns with wheat price at 1/						
			\$1.16	\$1.36 2/	\$1.42	\$1.49	\$1.57	\$1.94	\$3.22
<u>Crop enterprise</u>									
Wheat . . . . .	:	Ac.:	0	0	74	233	476	487	506
Sorghum, grain . . . . .	:	" :	519	519	446	285	43	33	17
Sorghum, silage . . . . .	:	" :	15	15	15	16	14	13	11
<u>Alfalfa hay . . . . .</u>									
Alfalfa hay . . . . .	:	" :	0	0	0	0	0	0	0
Fallow . . . . .	:	" :	0	0	5	16	33	34	17
Wild hay (native past.) . . . . .	:	" :	3	3	3	0	3	3	3
Native pasture (avail.) . . . . .	:	" :	337	337	337	340	337	337	337
<u>Production</u>									
Wheat . . . . .	:	Bu.:	0	0	1,178	3,720	7,610	7,784	8,018
Feed grain (corn equiv.) . . . . .	:	Bu.:	12,432	12,432	10,702	6,938	1,256	1,026	518
Beef - (net gain) . . . . .	:	Cwt.:	324	324	323	323	318	300	258
<u>Livestock enterprise</u>									
Cow-calf . . . . .	:	Cows:	0	0	0	0	0	0	0
Calf wintered . . . . .	:	No.:	157	157	156	156	154	133	87
Calf winter & sum, graze . . . . .	:	" :	0	0	0	0	0	8	26
Farm fed steers . . . . .	:	" :	0	0	0	0	0	0	0
<u>Labor used</u>									
- operator . . . . .	:	Hrs.:	2,038	2,038	2,079	2,044	1,839	1,769	1,615
- hired . . . . .	:	Hrs.:	164	164	74	7	51	58	72
<u>Operating capital (12 mo.)</u>									
	:	Dol.:	12,020	12,020	12,038	12,139	12,138	11,773	10,910
<u>Returns to operator's 3/</u>									
Lab.,mgt., fixed costs . . . . .	:	Dol.:	11,100	11,100	11,100	11,226	11,644	14,446	24,440
Labor & management . . . . .	:	Dol.:	204	204	204	330	748	3,550	13,544

1/Significant changes in farm organization occur at the wheat prices shown or enterprises enter or leave organization. 2/Feed grain equivalent price. 3/Fixed costs are \$10,896 (table 5).



Appendix table 7 --Effects of livestock enterprises on organization and returns, 901-acre farms,  
with \$1.06 wheat, \$.94 feed grain, Area III, Kansas

Item	Unit:	Grain - beef					Grain-hog					Grain-livestock									
		Grain-:	beef:	cow:	Grain-:	calf:	wtr.:	drylot:	steer:	Excl.:	+Calf:	+Cust.:	Grain-:	hog:	limit:	labor:	lvstk.:	labor:	lvstk.:	No:	wheat:
Crop enterprise																					
Wheat	Ac.	0	0	0	40	117	69	74	146	0	181	0	181	0	181	0	181	0	181	0	181
Sorghum, grain	"	534	528	528	443	400	175	445	370	515	329	509	329	509	329	509	329	509	329	509	329
Sorghum, silage	"	0	6	6	16	8	89	16	0	0	7	6	7	6	7	6	7	6	7	6	7
Alfalfa Hay	"	0	0	0	0	7	69	0	6	7	6	7	6	7	6	7	6	7	6	7	6
Hog past.(rye, sudan)	"	*	*	*	*	*	*	*	10	10	9	10	9	10	9	10	9	10	9	10	9
Fallow	"	0	0	0	38	9	136	5	11	1	14	1	14	1	14	1	14	1	14	1	14
Wild hay (native past.)	"	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3
Native pasture(avail.)	"	340	340	340	340	340	340	340	340	340	337	337	337	337	337	337	337	337	337	337	337
Production																					
Wheat	Bu.	0	0	0	644	1,873	1,353	1,174	2,332	0	2,893	0	2,893	0	2,893	0	2,893	0	2,893	0	2,893
Feed grain(corn equiv.)	Bu.	12,784	12,628	12,628	11,118	9,640	5,599	10,676	8,936	12,335	7,960	12,196	7,960	12,196	7,960	12,196	7,960	12,196	7,960	12,196	7,960
Beef (net gain)	Cwt.	*	110	110	320	304	1,082	953	*	*	198	182	198	182	198	182	198	182	198	182	198
Pork (net gain)	Cwt.	*	*	*	*	*	*	*	1,286	1,373	1,236	1,357	1,236	1,357	1,236	1,357	1,236	1,357	1,236	1,357	1,236
Livestock enterprise																					
Cow-calf	Cows:	*	26	26	0	0	20	0	*	*	0	0	0	0	0	0	0	0	0	0	0
Calf wintered-drylot	No.	*	*	*	*	*	329	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Calf wintered	"	*	*	*	155	*	13	157	*	*	19	0	19	0	19	0	19	0	19	0	19
Calf winter & sum.graze	"	*	*	*	0	56	0	0	*	*	53	61	53	61	53	61	53	61	53	61	53
Farm fed steers	"	*	*	*	0	35	0	0	*	*	0	0	0	0	0	0	0	0	0	0	0
Custom fed steers	"	*	*	*	*	*	*	157	*	*	*	*	*	*	*	*	*	*	*	*	*
Sows-(2 litters)	"	*	*	*	*	*	*	*	37	39	35	39	35	39	35	39	35	39	35	39	35
Labor used - operator																					
- hired	Hrs.	1,078	1,442	1,442	2,063	1,902	2,378	2,078	2,032	2,104	2,380	2,334	2,380	2,334	2,380	2,334	2,380	2,334	2,380	2,334	2,380
Operating capital (12mo.)	Dol.	59	97	97	46	48	2/ 560	124	3/211	309	4/472	693	4/472	693	4/472	693	4/472	693	4/472	693	4/472
Operating capital (12mo.)	Dol.	1,595	7,641	7,641	12,060	11,965	27,989	32,118	8,272	8,583	15,837	16,053	15,837	16,053	15,837	16,053	15,837	16,053	15,837	16,053	15,837
Return to operators	5/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/	6/
Labor, fixed costs	Dol.	-6,992	6,504	6,504	8,061	7,348	11,960	9,516	15,464	16,225	15,252	15,935	15,252	15,935	15,252	15,935	15,252	15,935	15,252	15,935	15,252
Labor & management	Dol.	-3,904	-4,391	-4,391	-2,835	-3,548	1,064	-1,380	4,563	5,329	4,356	5,039	4,356	5,039	4,356	5,039	4,356	5,039	4,356	5,039	4,356

1/Wheat can be sold to purchase lower priced feed grains for feeding at \$.10 Bu. above market price.

2/Labor limiting in September and October. 3/Labor limiting May. 4/Labor limiting March and May.

5/Fixed costs are \$10,896 (table 5) 6/Unused native pasture is rented @ \$4.50 per acre.

\* Enterprise not permitted in analysis.







Appendix table 9 --Effects of livestock enterprises on organization and returns, 901-acre farms, with \$1.81 wheat, \$.94 feed grain, Area III, Kansas

Item	Unit	Grain - beef				Grain - hog				Grain-livestock			
		Grain	beef	Excl.	+Calf	Grain	hog	limit	No	Grain	labor	limit	No
		500	495	486	491	404	485	146	50	336	336	336	477
Wheat	Ac.	34	34	33	34	28	33	370	466	174	174	174	33
Sorghum, grain	"	0	4	14	6	60	16	0	0	9	9	9	10
Sorghum, silage	"	0	0	0	3	35	0	6	7	6	6	6	5
Alfalfa hay	"	*	*	*	*	*	*	10	10	9	9	9	8
Hog past.(rye, sudan)	"	34	34	33	34	35	33	11	5	24	24	24	34
Fallow	"	0	3	3	3	3	0	0	0	3	3	3	3
Wild hay(native past.)	"	340	337	337	337	337	340	340	340	337	337	337	337
Native pasture(avail.)	"												
Production													
Wheat	Bu.	7,983	7,915	7,768	7,835	6,459	7,748	2,332	797	5,364	5,364	5,364	7,620
Feed grain(corn equiv.)	Bu.	1,052	1,043	1,024	1,032	851	1,021	8,936	11,173	4,319	4,319	4,319	1,094
Beef (net gain)	Cwt.	*	97	318	228	785	939	*	*	232	232	232	253
Pork (net gain)	Cwt.	*	*	*	*	*	*	1,286	1,343	1,114	1,114	1,114	1,011
Livestock enterprise													
Cow-calf	cows	*	22	0	0	0	0	*	*	0	0	0	0
Calf wintered-drylot	No.	*	*	*	*	187	*	*	*	*	*	*	*
Calf wintered	"	*	*	154	*	70	155	*	*	58	58	58	82
Calf winter & sum.graze	"	*	*	0	55	30	0	*	*	37	37	37	27
Farm fed steers	"	*	*	0	17	0	0	*	*	0	0	0	0
Custom fed steers	"	*	*	*	*	*	155	*	*	*	*	*	*
Sows-(2 litters)	"	*	*	*	*	*	*	37	39	32	32	32	29
Labor used - operator	Hrs.	774	1,124	1,830	1,452	2,240	1,879	2,032	2,094	2,403	2,403	2,403	2,299
- hired	Hrs.	57	66	55	96	2/ 354	55	3/ 210	260	345	345	345	331
Operating capital (12mo)	Dol.	2,035	7,320	12,141	10,228	21,952	31,914	8,272	8,477	15,983	15,983	15,983	15,954
Returns to operators	4/	5/	5/	5/	5/	5/	5/	5/	5/	5/	5/	5/	5/
Lab.,mgt.,fixed costs	Dol.	12,007	11,476	13,365	12,346	13,803	14,852	16,164	16,224	16,249	16,249	16,249	19,133
Labor & management	Dol.	1,111	580	2,469	1,450	2,907	3,956	5,268	5,328	5,353	5,353	5,353	8,237

1/Wheat can be sold to purchase lower priced feed grains for feeding @ \$.10 bu. above market price.  
2/Labor limiting in September and October. 3/Labor limiting May. 4/Fixed costs are \$10,896, (table 5.)  
5/Unused native pasture is rented @ \$4.50 per acre. \* Enterprise not permitted in analysis.



Appendix table 10 - Effects of purchasing feed grain on organization and returns of 901 - acre grain-livestock farms,  $\frac{1}{2}$  with \$.94 feed grain, different wheat prices Area III, Kansas

Item	Unit	Wheat at \$.94		Wheat at \$1.06		Wheat at \$1.25		Wheat at \$1.51	
		No purch.	allowed	No purch.	allowed	No purch.	allowed	No purch.	allowed
Crop enterprise									
Wheat . . . . .	Ac.	157	157	181	181	181	181	336	477
Sorghum, grain . . . . .	"	334	334	329	329	329	329	174	33
Sorghum, silage . . . . .	"	7	7	7	7	7	7	9	10
Alfalfa hay . . . . .	"	6	6	6	6	6	6	6	5
Hog past.(rye, sudan) . . . . .	"	9	9	9	9	9	9	9	8
Fallow . . . . .	"	0	0	14	14	14	14	24	34
Wild hay (native past.) . . . . .	"	3	3	3	3	3	3	3	3
Native pasture(avail.) . . . . .	"	337	337	337	337	337	337	337	337
Production									
Wheat . . . . .	Bu.	2,511	2,511	2,893	2,893	2,893	2,893	5,364	7,620
Feed grain(corn equiv.) . . . . .	Bu.	8,331	8,331	7,960	7,960	7,960	7,960	4,319	1,004
Beef (net gain) . . . . .	Cwt.	204	204	198	198	198	198	232	253
Pork (net gain) . . . . .	Cwt.	1,224	1,224	1,236	1,236	1,236	1,236	1,114	1,011
Grain Purchased- for feed 2/3	Bu.	0	W-4,443	0	0	0	FG-1,953	0	FG-5,144
price paid . . . . .	\$/Bu	-	\$1.04	-	-	-	\$1.04	-	\$1.04
Livestock enterprise									
Cow-calf . . . . .	Cows	0	0	0	0	0	0	0	0
Calf wintered . . . . .	No.	27	27	19	19	19	19	58	82
Calf winter & sum. graze . . . . .	"	49	49	53	53	53	53	37	27
Farm fed steers . . . . .	"	0	0	0	0	0	0	0	0
Sows-(2 litters) . . . . .	"	35	35	35	35	35	35	32	29
Labor used - operator . . . . .	Hrs.	2,382	2,382	2,380	2,380	2,380	2,380	2,403	2,299
- hired . . . . .	Hrs.	464	464	3/ 472	3/ 472	3/ 472	3/ 472	345	331
Operating capital(12 mo.) . . . . .	Dol.	15,929	15,929	15,837	15,837	15,837	15,837	15,983	15,954
Returns to Operators 4/									
Lab.,mgt., fixed costs . . . . .	Dol.	15,124	15,178	15,252	15,252	15,472	15,611	16,249	19,133
Labor & management . . . . .	Dol.	4,228	4,282	4,356	4,356	4,576	4,715	5,353	8,237

$\frac{1}{2}$ Wheat or feed grain can be sold to purchase the lower priced grain to feed at \$.10 Bu. above market price of grain sold.  $\frac{2}{3}$ Wheat purchased and feed grain sold. FG=Feed grain purchased and wheat sold. Price paid is \$.10 Bu. above price received for same grain.  $\frac{3}{4}$ Labor limiting in March and May.  $\frac{4}{5}$ Fixed costs are \$10,896, table 5.



**Appendix table 11**--Effects of farm size on organization and returns of grain-beef farms with \$.94 feed grain, Area III, Kansas 1/

Organization and returns by farm size with wheat price at									

1/Farm sizes: small 540 acres; average 901 acres; large 1,352 acres. 2/No limit on hired labor large farm.  
3/Fixed costs are \$7,404 small farm; \$10,896 average; and \$15,066 large (table 5).



Appendix table 12 --Effects of crop yields on organization and returns of 901-acre grain-beef farm, with \$.94 feed grain, Area III, Kansas

Organization and returns for crop yield levels with wheat at 1/										
		\$1.06 per bushel			\$1.25 per bushel			\$1.81 per bushel		
Item	Unit	Low	Average	High	Low	Average	High	Low	Average	High
Crop enterprise										
Wheat	Ac.	1/323	40	1/0	484	475	476	485	486	487
Sorghum, grain	"	194	443	519	33	44	43	33	33	33
Sorghum, silage	"	17	16	15	17	16	15	15	14	14
Alfalfa Hay	"	0	0	0	0	0	0	0	0	0
Fallow	"	22	38	0	33	33	33	33	33	33
Wild hay (native past.)	"	0	0	0	0	0	0	3	3	3
Native pasture(avail.)	"	340	340	340	340	340	340	337	337	337
Production										
Wheat	Bu.	4,141	644	0	6,206	7,581	9,096	6,221	7,768	9,314
Feed grain(corn equiv.)	Bu.	3,844	11,118	14,883	815	1,267	1,512	817	1,024	1,230
Beef (net gain)	Cwt.	274	320	373	272	320	368	271	318	365
Pork (net gain)	Cwt.	*	*	*	*	*	*	*	*	*
Livestock enterprise										
Cow-calf	Cows	0	0	0	0	0	0	0	0	0
Calf wintered	No.	133	155	180	132	155	178	131	154	176
Calf winter &sum. graze	"	0	0	0	0	0	0	0	0	0
Farm fed steers	"	0	0	0	0	0	0	0	0	0
Labor used - operator	Hrs.	1,846	2,063	2,100	1,686	1,843	1,989	1,685	1,830	1,975
- hired	Hrs.	0	46	251	54	51	51	55	55	55
Operating capital (12 mo.)	Dol.	10,351	12,060	13,805	10,348	12,199	14,049	10,300	12,141	13,980
Returns to operators 2/										
Lab.,mgt.,fixed costs	Dol.	5,807	8,061	10,312	6,878	9,098	11,315	10,302	13,365	16,425
Labor & management	Dol.	-5,089	-2,835	-584	-4,018	-1,798	419	-594	2,469	5,529

1/Low yields, 20% below; high yields, 20% above the area average. 2/Fixed costs, \$10,896 (table 5).





